*03M11A14*

SD1037

SYSTRON DONNER

# Concord Instrument Division

# INSTRUCTION MANUAL

CONCORD INSTRUMENT
DIVISION

MODEL 1037

50 MHz COUNTER

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# CHAPTER 1

# GENERAL INFORMATION

## 1.1 GENERAL DESCRIPTION

The SD 1037 Counter-Timer is an all solid state instrument capable of direct frequency measurements up to 50 MHz and period measurements with 100 ns resolution. The basic modes of measurement without the use of optional plug-in units include: Rate (frequency), Count (totalizing), Period, and Period Average (where the sum of 10 or 100 consecutive samples is displayed to obtain an average or more accurate reading). Eight digit in-line indicators display the measured quantity with annunciation of unit and auto-positioned decimal point.

Accuracy of measurement is ±1 count ± time base stability. Time base stability for the standard SD 1037 is less than 3 parts in $10^7$ per week set by the aging rate of the instrument's internal standard oscillator. The oscillator signal frequency is also available as an output; either as the fundamental (1 MHz) or scaled (1 MHz/$10^X$). Increased stability may be obtained by using an external standard (which may be connected to the instrument by a jack on the rear panel) or by replacing the standard internal oscillator with an optional high-stability unit.

## 1.2 SPECIFICATIONS

Specifications for the SD 1037 Counter-Timer are as follow:

FREQUENCY MEASUREMENTS

**Range:** Model 1037: 0 to 50 MHz.

**Gate Time:** 1 µsec to 10 sec in decade steps.

**Accuracy:** ±1 count ± time base accuracy.

Reads In: KHz or MHz with positioned decimal point; units annunciator in line with digital display.

Self Check: Counts 10 MHz for the gate time chosen by the TIME BASE selector switch.

SCALING

**Frequency Range:** 10 kHz to 2 MHz.

**Factor:** By decades up to $10^7$ switch selected on front panel.

**Input:** Rear panel.

**Output:** In place of time base output frequencies.

**Sensitivity:** 1 V rms

PERIOD AVERAGE MEASUREMENTS

**Range:** Single Period ... 0 to 1 MHz.
Multiple Period . 0 to 1 MHz.

**Periods Averaged:** 1 period to $10^2$ periods in decade steps.

**Accuracy:** ±1 count ± time base accuracy ± trigger error.*

**Frequency Counted:** 1 Hz to 10 MHz in decade steps

Reads In: Sec, ms, µs, with positioned decimal point; units annunciator in line with digital display.

RATIO MEASUREMENTS (using Rate function)

Displays: $(f_1/f_2)$ times multiplier $\times 10^6$.

Range: $f_1$: 0 to 50 MHz; $f_2$: 10 kHz to 2 MHz. Ratios averaged 1 to $10^7$ in decade steps (selected by TIME BASE switch).

*Trigger error is less than ±0.3% of one period : periods averaged for signals with 40 db or better signal-to-noise ratio.

**Sensitivity:** 0.1 V rms, $f_1$ input; 1 V rms, $f_2$ input.

**Accuracy:** ±1 count of $f_1$ ± trigger error* of $f_2$. $f_1$ is frequency applied to the decimal counters (enters C input jack). $f_2$ is frequency applied to decade dividers (enters EXT Time Base jack on rear panel).

**Reads In:** Dimensionless; annunciator and decimal point not applicable.

TIME BASE

**Frequency (internal):** 1 MHz.

**Stability:** Aging rate - Model 1037: less than 3 parts in $10^7$ per week after 1 hour warm-up. As a function of temperature - Model 1037: less than ±2 parts in $10^8$ per °C from +20°C to +55°C. As a function of line voltage - less than ±2 parts in $10^8$ for ±10% change in line voltage from 115 V or 230 V rms.

**Short-Term:** Less than 1 part in $10^8$ rms with measurement averaging time of one second under constant environmental and line voltage conditions.

**Adjustment Range:** approx. 4 parts in $10^5$ available from top of crystal oven.

**Output Frequencies:** Rear panel; 1 MHz 3 volts p-p minimum, available uninterrupted in all functions. Output impedance 1000Ω nominal.

**Front Panel:** 0.1 Hz to 10 MHz in decade steps selected by TIME BASE switch, 470Ω output impedance, 6 V p-p rectangular waveform. Stability of both outputs same as internal time base.

**External Standard Frequency:** 1 MHz, 1 volt rms into 1000Ω required at rear panel BNC connector.

GENERAL

**Registration:** 8 digits in-line, 99,999,999 max. display; readout includes units annunciator and auto-positioned decimal point.

**Display Storage:** Provides a continuous display of the most recent measurement. This display is held even while the instrument is gated for a new count. If the new count differs from the stored count, the display will shift to the new reading directly.

**Sample Rate:** Time following the gate closing during which the gate may not be reopened is continuously variable from less than 0.2 sec to 5 sec in frequency mode, independent of gate time; display can be held indefinitely. Manual reset by pushbutton.

**Operating Temperature Range:** -20°C to +65°C.

**Storage Temperature Range:** -55°C to +85°C

**Signal Input:** (C input channel on front panel).

Maximum Sensitivity: 100 mV, rms

Coupling: AC or DC, switch selectable

Attenuation: Step attenuator with factors of 1, 10, and 100.

Level: Selects dc trigger level point of input signal at A input from +1 V to -1 V times attenuation factor. This permits triggering on either positive or negative pulses at the dc level selected.

Impedance: 100kΩ/volt (10kΩ at 100 mV) approx. 40 pF.

Overload: ±5 V peak in "1" position; ±25 V peak in "10" position; ±75 V peak in "100" position of RANGE switch. DC level is ±500 V maximum when AC-DC switch is set to AC.

*See note on preceeding page

**Dimensions:** 5 1/4" high by 17 1/2" wide by 18" deep (13.3 x 44.3 x 45.6 cm). Rack mount (MIL-STD-189).
**Weight:** 35 lbs (15.8 kg) net, with blank plug-in; 47 lbs (21.3 kg) shipping.
**Power Supply:** 115 or 230 V ±10% 50 to 60 Hz; 125 watts.
**Front Panel Paint:** FED-STD-595, color No. 26440.
**Accessories Furnished:** SD No. 10338 coaxial cable 6 feet long, male BNC one end.

## 1.3 STANDARD OPTIONS AND PLUG-IN UNITS

Table 1-1 lists the SD Plug-in units compatible with the standard SD 1037 and Table 1-2 lists the options available for this instrument. Table 1-3 compares the performance factors of the standard oscillator and oscillator options.

TABLE 1-1
PLUG-IN UNITS
COMPATIBLE WITH SD 1037

| MODEL | TITLE | PRIMARY FUNCTION |
|---|---|---|
| 1253 | ACTO, 300-3,000 MHz | Automatic frequency extender |
| 1255A | ACTO, 3 - 12.4 GHz | Automatic frequency extender |
| 1257 | ACTO, 12 - 18 GHz | Automatic frequency ext., 12 to 18 GHz, ±12% of center freq. |
| 1291 | 50-512 MHz Het Conv. | Ext. Freq. range of counter |
| 1292 | 15 GHz Transf. Osc. | Ext. Freq. range of counter |
| 1295 | 3 GHz Het. Conv. | Ext. Freq. range of counter |
| 1297 | 26 GHz Transf. Osc. | Ext. freq. range of counter |
| 1979H | 350 MHz prescaler | Ext. freq. range of counter |
| 1924 | Dual Measurement amplifier | Dual channel period measurement with automatic switching |
| 1926A | Time Interval | Dual input channel |
| 1936 | Integrating DVM | DC voltage measurements |
| 1944A | Preset | Highly variable preset control |
| 1948A | Video Amplifier | Increases sensitivity to 1 mV from 10 Hz to 50 MHz |
| 300 | 3 Plug-in Expander | Any 3 plug-ins interconnected to one counter |

TABLE 1-2
OPTIONS AVAILABLE FOR SD 1037

OSCILLATOR OPTIONS

**OPTION B3: Medium Stability Oscillator**
AGING RATE: Better than 3 parts in $10^9$/24 hours.

**OPTION B: High Stability Oscillator**
AGING RATE: Better than 1 part in $10^9$/24 hours.

**OPTION B4: Super High Stability Oscillator**
AGING RATE: Better than 5 parts in $10^{10}$/24 hours.

(continued)

## DIGITAL OUTPUT OPTIONS

**OPTION D1: 1-2-4-8 BCD Output**

Compatible with H-P Model 562A Printer with 1-2-4-8 positive logic.

COLUMN CAPACITY: 8 maximum plus decimal point and measurement unit indication.

PRINT COMMAND: Step each end-of-conversion from +30 V to 0 V, 47 kΩ impedance. 100 msec min. after print command.

INHIBIT RESET: Contact closure to ground of H-P 562A circuitry.

INPUT LOGIC: "1" = 0 V ±0.5 V; "0" = -6 V ±0.5 V.

POSITIVE REF: 0 VDC NEGATIVE REF: -6 VDC.

PIN CONNECTIONS: Compatible with HP 562A with HP pin-to-pin cable.

**OPTION D2: 1-2-2-4 BCD Output**

Compatible with HP Model 562 Printer with 1-2-2-4 positive logic.

COLUMN CAPACITY: Same as Option D1.

PRINT COMMAND: Same as Option D1.

Inhibit Reset: Same as Option D.

INPUT LOGIC: "1" = +30 V ±0.5 V, 100 kΩ source impedance; "0" = 0 V ±1 V, 0.5 mA max.

POSITIVE REF: +25 V. NEGATIVE REF: +6 V.

PIN CONNECTIONS: Same as Option D1

**OPTION F: 1MΩ Input Impedance**

Addition of FET input amplifier circuit to increase input impedance to 1 MΩ, shunted by 25 pF, on all attenuation ranges of counters 1017, 1018, 1037, and 1038.

TABLE 1-3
COMPARISON OF STANDARD AND OPTIONAL OSCILLATORS

| | Standard Oscillator | Med. Stability Oscillator OPTION B3 | High Stability Oscillator OPTION B | Super High Stability Oscillator OPTION B4 |
|---|---|---|---|---|
| Aging Rate | <5 parts in $10^8$/24 hrs. | <3 parts in $10^9$/24 hrs. | <1 part in $10^9$/24 hrs. | <5 parts in $10^{10}$/24 hrs. |
| Warm-up time to reach specified aging rate | ←within 72 hours→ | | ←within 48 hours→ | |
| Accuracy 1 hour after turn-on referenced to previous turn-off | ←not applicable→ | | ←<1 part in $10^{10}$ from turn-off frequency→ | |
| Short-term stability averaged over 1 sec. | 1 part in $10^8$ rms | 2 parts in $10^{10}$ rms | ←1 part in $10^{10}$ rms→ | |
| Variation with Temperature -20°C to +55°C | ±2 parts in $10^8$/°C | Aver. ±2 parts in $10^{10}$/°C | ←Average ±5 parts in $10^{11}$/°C→ | |

(continued following page)

| | Standard Oscillator | Med. Stability Oscillator OPTION B3 | High Stability Oscillator OPTION B | Super High Stability Oscillator OPTION B4 |
|---|---|---|---|---|
| Vibration 5-55 Hz, 0.016" DA | ←not applicable→ | | ← ±2 parts in $10^8$ (meets MIL-STD-167)→ | |
| Shock 50 g 11 msec | ←not applicable→ | | ← <±1 part in $10^8$ (meets MIL-STD-202A→ | |
| ±10% change in line voltage | <±2 parts in $10^8$ | ±5 parts in $10^{10}$ | ±5 parts in $10^{10}$ | ±5 parts in $10^{11}$ |
| Storage Temperature | -55°C to +85°C | | ← -65°C to +85°C→ | |
| Long-Term Aging Rate | <3 parts in $10^7$/7 days | <2 parts in $10^8$/7 days | <3 parts in $10^8$/30 days | <1.5 parts in $10^8$/30 days |

## 1.4 EQUIPMENT SUPPLIED

TABLE 1-4
EQUIPMENT SUPPLIED

| QUANTITY PER EQUIPMENT | NAME | DESIGNATION | WEIGHT |
|---|---|---|---|
| 1 | Counter-Timer | SD 1037 | 35 lbs (15.8kg)* |
| 2 | Instruction Manual | SD 1037 | 47 lbs (21.3kg)** |
| 1 | Coaxial Cable, 6.0' | | *with blank plug-in |
| 1 | Blank plug-in | SD 10338 | **shipping weight |
| 1 | Rack Mounting Kit | SD 1/350 | |

## 1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED

A list of the equipment and publications required but not supplied for the operation, troubleshooting, and maintenance of the SD 1037 is shown in Table 1-5.

| QUANTITY PER EQUIPMENT | NAME | DESIGNATION | REQUIRED USE |
|---|---|---|---|
| 1 | Oscilloscope, wide band with dual-trace plug-in | Tektronix Model 581 with Model 82 plug-in | Troubleshooting and Calibration |
| 1 | Time Interval Measurement Plug-in | Systron-Donner SD 1926A | Troubleshooting and Calibration of Period and Ratio measurement functions. |

TABLE 1.5 EQUIPMENT REQUIRED

TABLE 1.5 (con't.)

| QUANTITY PER EQUIPMENT | NAME | DESIGNATION | REQUIRED USE |
|---|---|---|---|
| 1 | Volt-ohm-milliameter; 2%FS DC; 100kΩ/V sensitivity | Simpson 260 or equivalent | Troubleshooting |
| 1 | DC Differential Voltmeter; 0 to ±300V; 1% FS | Fluke 801 or equivalent | Calibration |
| 1 | Signal Generator; 10 Hz to 1 kHz, 100mV output | Hewlett-Packard 202A or equivalent | Troubleshooting and Calibration |
| 1 | Signal Generator, 1 kHz to 50 MHz, 100 mV output | Hewlett-Packard 606A or equivalent | Troubleshooting and Calibration |
| 1 | Square-Wave Generator; 0-10 MHz, 10V output | Hewlett-Packard 211A or equivalent | Troubleshooting and Calibration |
| 1 | Blank Plug-in | SD 1942 | Operation of instrument |
| 1 | Metered Autotransformer; 115 VAC, ±10%, 4A | General Ratio W5MT3A or equivalent | Calibration |
| 1 | Frequency Standard; 1 MHz, 1 part in $10^{10}$ short-term stability | Hewlett-Packard 107BR or equivalent | Calibration |
| 1 | PC Board Extender; 10-pin | SD 11333 | Access to PC board circuitry |
| 1 | PC Board Extender; 15-pin | SD 11334 | Access to PC board circuitry |
| 1 | PC Board Extender; 22-pin | SD 11331 | Access to PC Board circuitry. |

## 1.6 PREPARATION FOR RESHIPMENT

Should reshipment become necessary, contact the nearest Systron-Donner field office for shipping instructions. If possible, use the original packaging materials or repack in accordance with MIL-P-116 and MIL-E-1755E. Systron-Donner field offices can provide materials similar to those used for original factory packaging. All correspondence should refer to the full nomenclature and serial number of the instrument involved.

## 1.7 CUSTOM MODIFICATIONS

Special features may be included to customize an SD digital instrument to particular requirements. These are: 1) RFI shielding; 2) 50-400Hz Line Frequency; 3) Remote Reset; 4) Special Panel Height; and 5) Rack Mount slides.

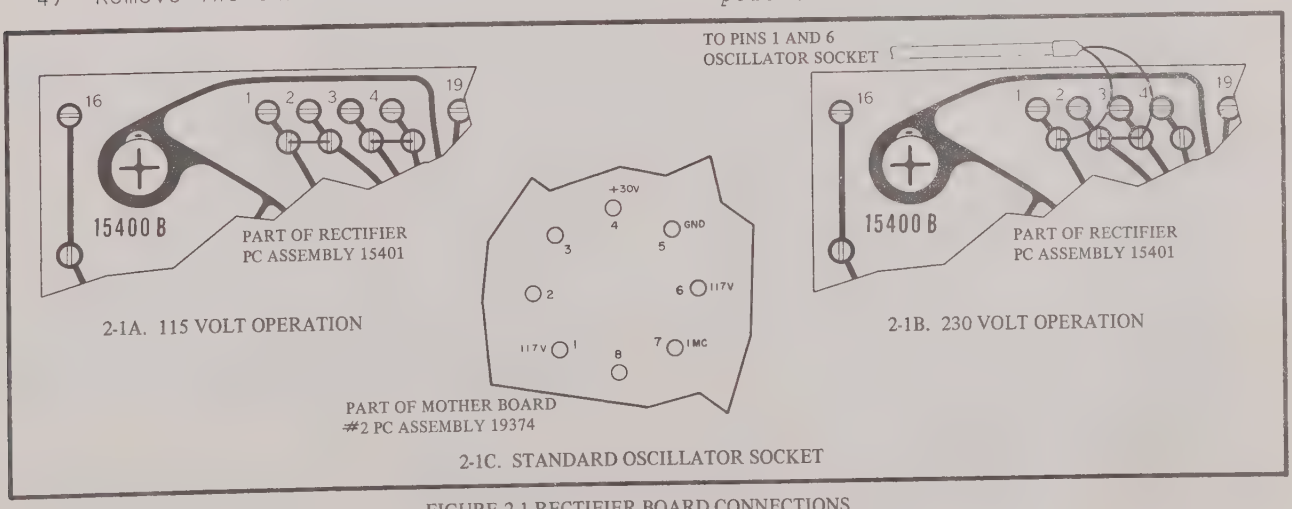
# CHAPTER 2
# INSTALLATION

## 2.1 POWER REQUIREMENTS

The SD 1037 is designed to operate from either a 115 or 230 volt, ±10%, 50-60 Hz source. Total power consumed, with blank plug-in installed, does not exceed 125 watts. The instrument is normally factory wired for 115 volt operation. To convert the SD 1037 to 230 volt operation, proceed as follows:

1) Remove the two wire straps between terminals 1-2 and 3-4 on the rectifier board (Figure 2-1A).
2) Install a wire strap between terminals 2 and 3 on the rectifier board (Figure 2-1B).
3) Remove the cable leads labeled 301 (red) and 302 (black) from pins 1 and 6 of the standard oscillator socket on mother board #2 (Figure 2-1C) and from fuseholders XF1 and XF2. Discard this cable.
4) Remove the cable leads labled 303 (red) and 304(black) from pins 1 and 6 of the standard oscillator socket and re-connect the black lead to fuseholder XF1 and the red lead to fuseholder XF2.
5) Connect a new cable from terminals 1 and 3 of the rectifier board (Figure 2-1B) to pins 1 and 6 of the oscillator socket.
6) Change the value of the line fuses (F1 and F2) from 1.5 amps to 0.75 amps.
7) Conspicuously label the instrument for 230V operation.

*NOTE: With the standard oscillator installed and the instrument operating from a 115 volt source, the oscillator oven receives power when the line cord is connected to the power receptacle. However, when the instrument is wired for 230 volt operation, the front panel POWER switch must be in the ON position to provide oscillator oven power.*




2-1A. 115 VOLT OPERATION

2-1B. 230 VOLT OPERATION

PART OF MOTHER BOARD
#2 PC ASSEMBLY 19374

2-1C. STANDARD OSCILLATOR SOCKET

FIGURE 2-1 RECTIFIER BOARD CONNECTIONS

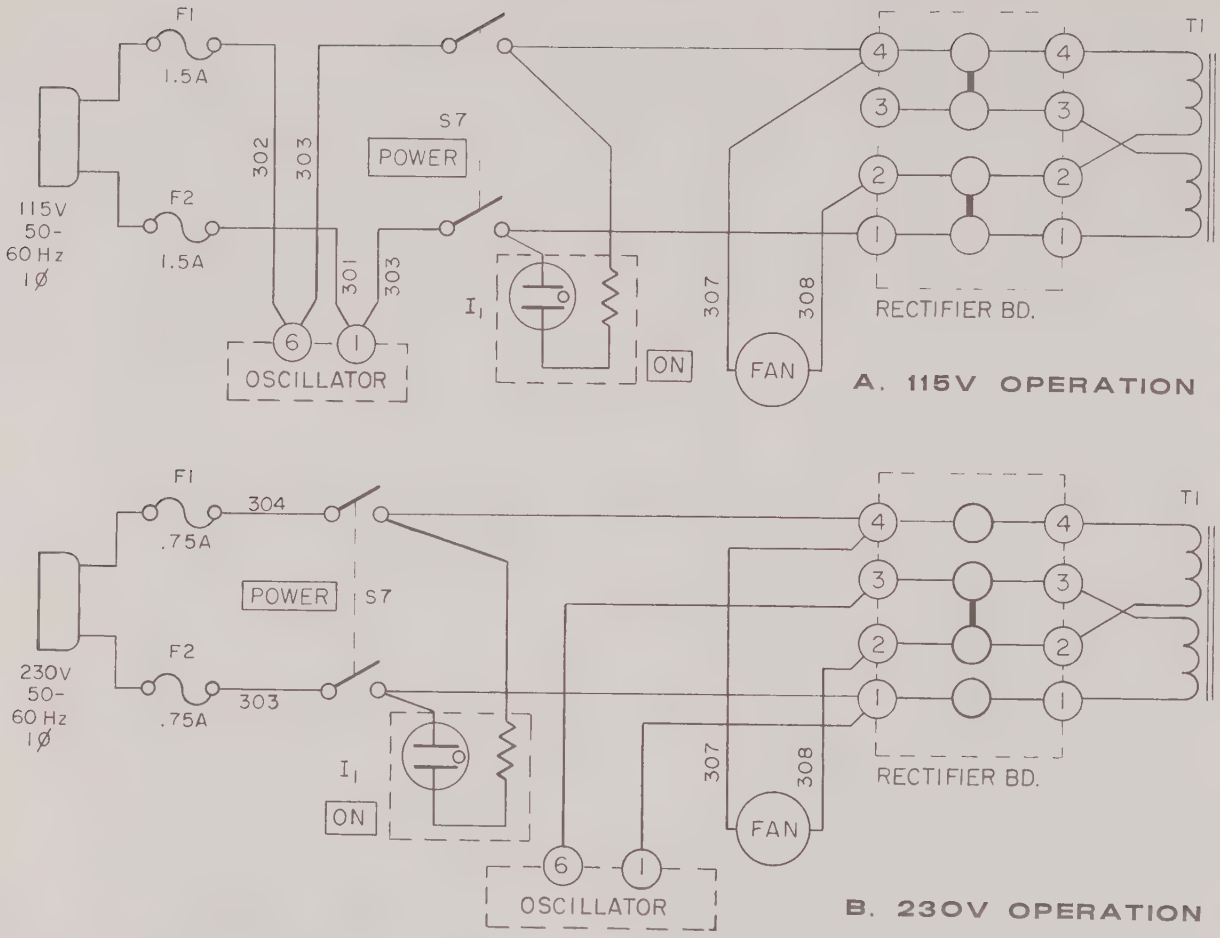



**FIGURE 2-2** Primary Power Distribution - 115V and 230V Operation

## 2.2 INSTALLATION REQUIREMENTS

The instrument uses forced-air cooling provided by a fan mounted in the rear-panel. Allow a minimum of 6 inches behind the rear-panel to permit proper air flow. Do not operate the instrument, whether bench or rack-mounted, for long periods of time with top or bottom dust covers removed because this will disrupt the air flow around the subassemblies.

Outline dimensions are shown in Figure 2-3. The front view also illustrates the rack mount ears which are supplied with each instrument for rack-mount installation. If rack mounting is desired, the adapters are installed as follows:

1) Remove metal strips from instrument side panel channels, after removing hold down brackets (see Figure 2-4).

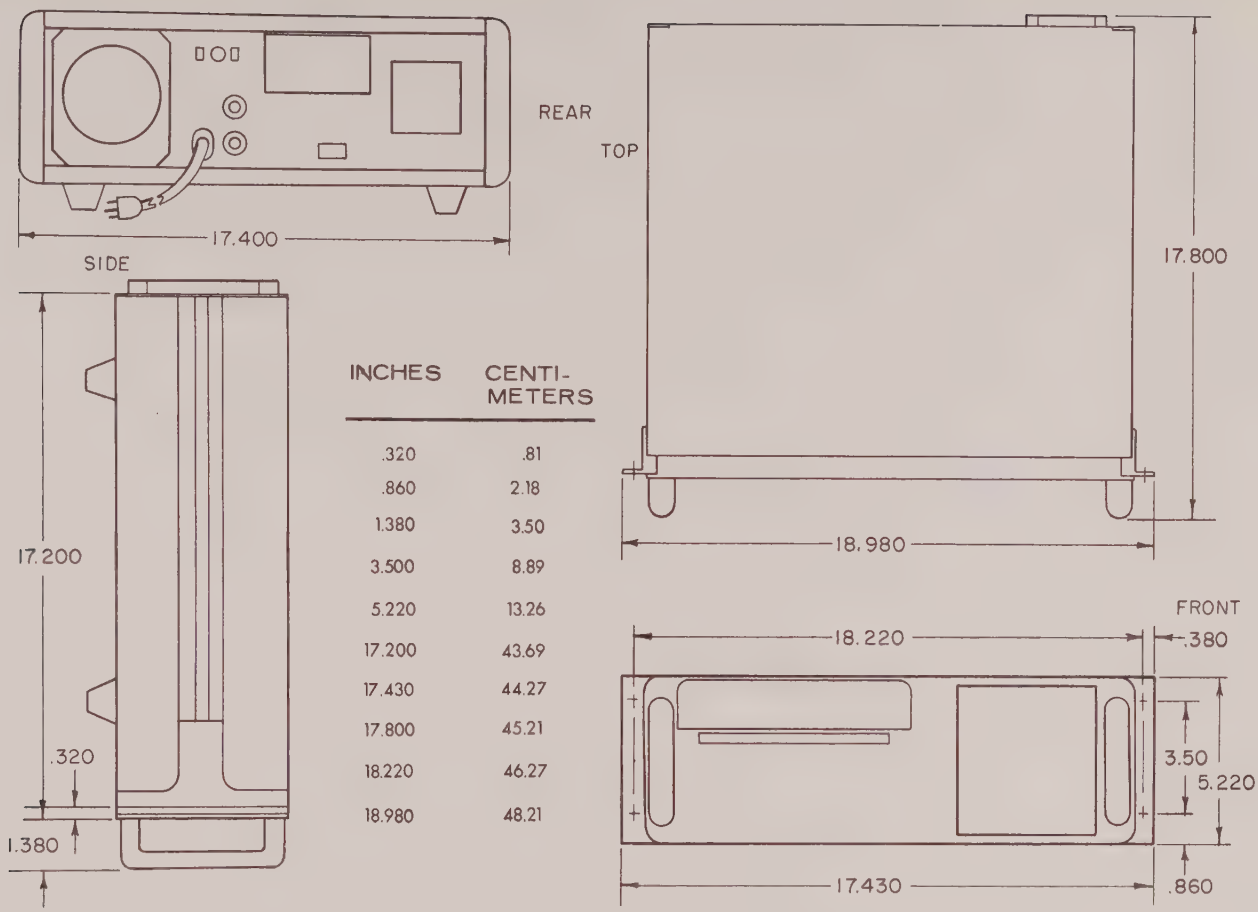
2) Remove bottom dust cover and unscrew studs mating rubber feet to the instrument stand and bottom panel.

3) Remove rubber foot stand mounting plate and collapsible stand.

4) Install SD 17125 adapter in mounting holes on each side of instrument using SD H1305 screws.

5) Replace bottom dust cover.

Either the blank plug-in or compatible plug-in assembly must be installed in the instrument prior to operation to complete electrical connections and provide proper air flow.




| INCHES | CENTI-METERS |
|---|---|
| .320 | .81 |
| .860 | 2.18 |
| 1.380 | 3.50 |
| 3.500 | 8.89 |
| 5.220 | 13.26 |
| 17.200 | 43.69 |
| 17.430 | 44.27 |
| 17.800 | 45.21 |
| 18.220 | 46.27 |
| 18.980 | 48.21 |

**FIGURE 2-3** Outline Dimensions

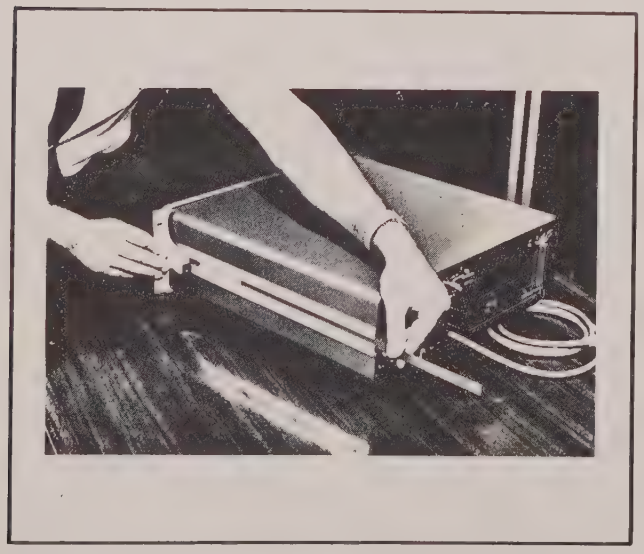


**FIGURE 2-4**

Removal of Metal Strip

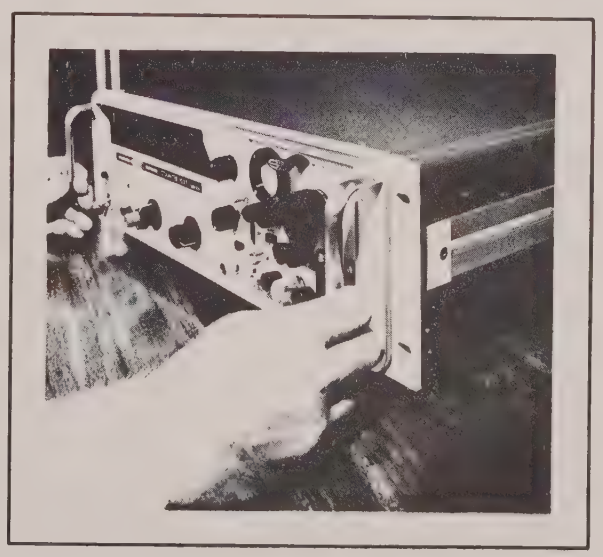


**FIGURE 2-5**

Instrument with Rack-Mount Installed

## 2.3 INSPECTION AND ADJUSTMENT

As soon as the instrument is received, verify that it is intact and as ordered. Check for loose or broken control knobs, bent or broken connectors, and dents or scratches on the panel surfaces. If damage of any nature is found, refer to the Warranty (inside back cover) and to Paragraph 1.6 for repackaging and shipping instructions. Perform an overall functional section test, following the procedure given in Chapter 3 of this manual.

All internal adjustments are initially made at the factory; the instrument is ready for use as received. Should the instrument fail to function properly or fail to meet specifications, contact your Systron-Donner Representative.

## 2.4 INTERFERENCE REDUCTION

If supplied with Option 1, the instrument is RFI shielded to meet MIL-I-26600 and MIL-I-6181D.

# CHAPTER 3

# OPERATION

## 3.1 FUNCTIONAL OPERATION

Interconnection of the functional sections of the SD 1037 may be made to provide the following modes of operation:

1) Direct frequency measurement of pulse or CW signals to 50 MHz, (Rate C).

2) Totalization of number of cycles applied to input (Count C).

3) Period and multiple period averaging measurement of one cycle of input waveform (PER A, PER A x 10, PER A x 100).

4) Ratio Measurement of two input frequencies ($f_2 f_1$).

5) Scaling of an input frequency ($f_1/10^X$).

6) Standard signal frequency source (1 MHz or 1 MHz/$10^X$).

7) Self-test (10 MHz).

When used in conjunction with a SD 1924 or 1926A Time Interval Measurement Plug-in, the following additional functions may be obtained:

1) Ratio Measurement C/A; i.e. measures number of cycles at input to counter during one cycle at input of plug-in.

2) Ratio measurement C/B-A; i.e., measureres number of cycles at input during time interval between two input signals to plug-in.

3) Time B-A; i.e., measures time interval between two input signals to plug-in.

For a detailed description of the measurement procedures for these additional functions, refer to the appropriate plug-in instruction manual.

The major functional sections of the SD 1037 are illustrated in the block diagram of Figure 3-1. These are:

1) Signal Input Amplifier
Converts the sinusoidal or pulsed input signals to uniform pulses. Front-panel controls permit selection of attenuation ratio and adjustment of trigger level. Provision is also made for switching the signal input connection to the plug-in connector.

2) Signal Switching Circuits
Allows a selected number of input pulses to pass to the counter section during a controlled timer interval. For the various modes of operation, the input pulse and time-interval sources are tabulated below:

| MODE | INPUT PULSE | TIME-INTERVAL |
|---|---|---|
| Frequency Measurement | Processed Input Signal | Selected Time Base Period |
| Totalize | Processed Input Signal | Started by 10 MHz signal from Time Base Section. Terminated manually by switching counter to "HOLD" function or by termination of input signal |

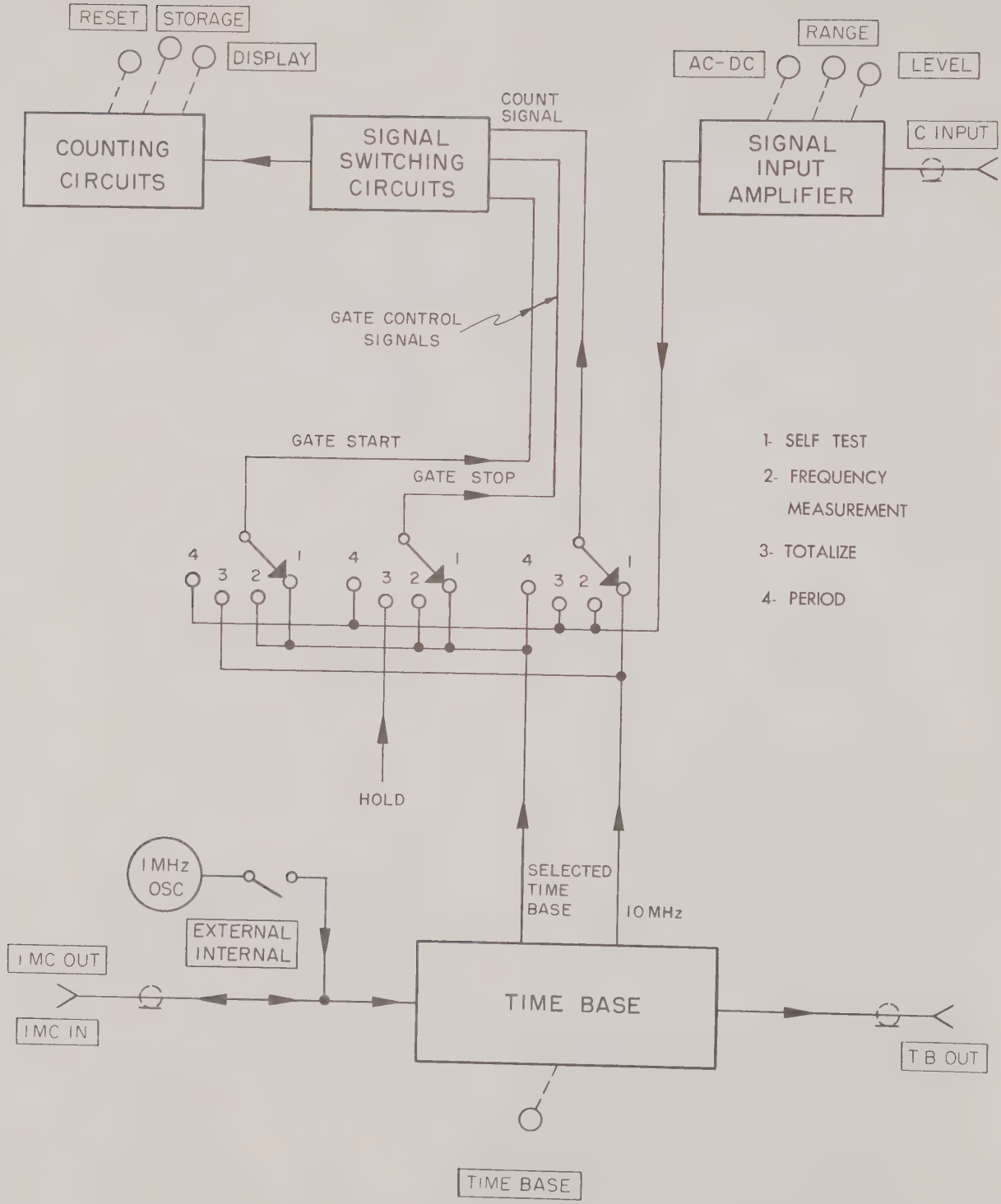



**FIGURE 3-1** BASIC BLOCK DIAGRAM - SD 1037 COUNTER-TIMER

| MODE | INPUT PULSE | TIME-INTERVAL |
|---|---|---|
| Period | Selected Time Base Frequency | One cycle of processed input signal |
| Self-Test | 10 MHz signal from time base section | Selected Time Base Period |

3) Time Base

Provides a precise time-interval signal derived from the internal standard oscillator (or from an external source) to control the signal gate. The time interval is selectable in decade steps by a front panel switch, and is available as an output at a front panel connector.

4) Counting Circuits

Totalizes the input signal pulses from the signal switching circuits during the selected time interval and displays the result as a numerical readout on an eight-digit in-line indicator including unit annunciation and positioned decimal point. A front-panel control permits adjustment of the display time before re-cycling and a rear panel switch permits either observation of the counting cycle in the counter decades or a continuous display of the most recent measurement.

5) Internal Standard

High-Stability oscillator that sets the accuracy of the instrument by providing the reference frequency for for the time base. A rear-panel switch permits selection of an external standard and a rear-panel connector makes the internal standard fundamental available as an output.

## 3.2 DESCRIPTION OF CONTROLS

Figures 3-2 and 3-3 locate all controls connectors and indicators on both front and rear panels and Table 3-1 provides a description of their function.

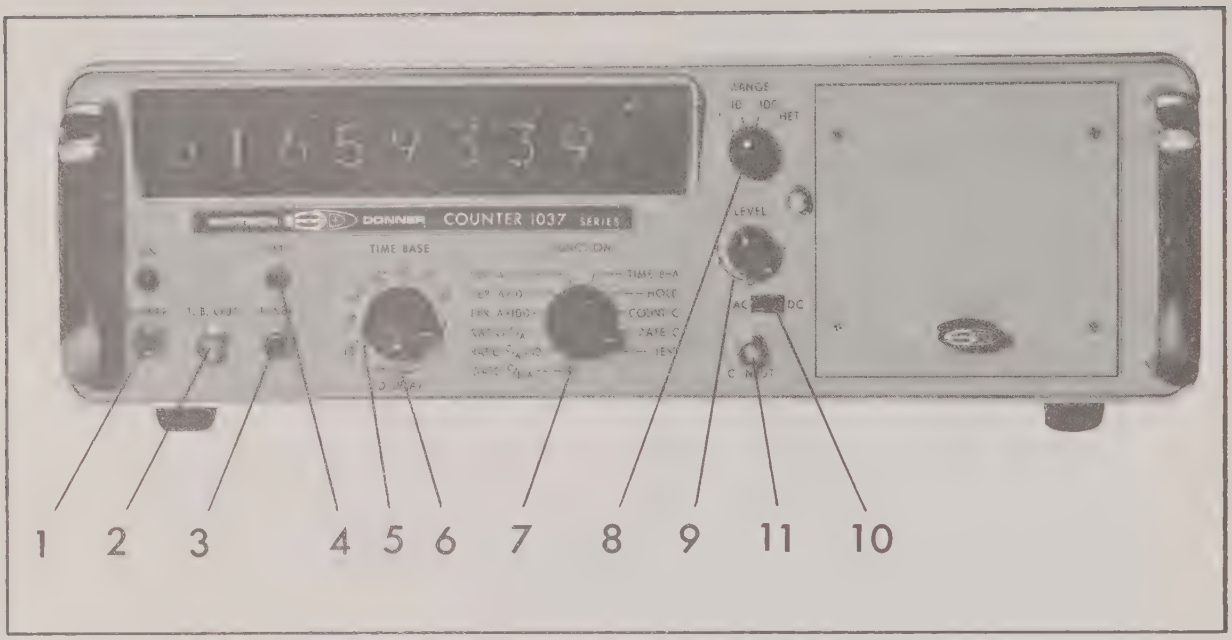



FIGURE 3-2 FRONT-PANEL SD 1037 COUNTER-TIMER

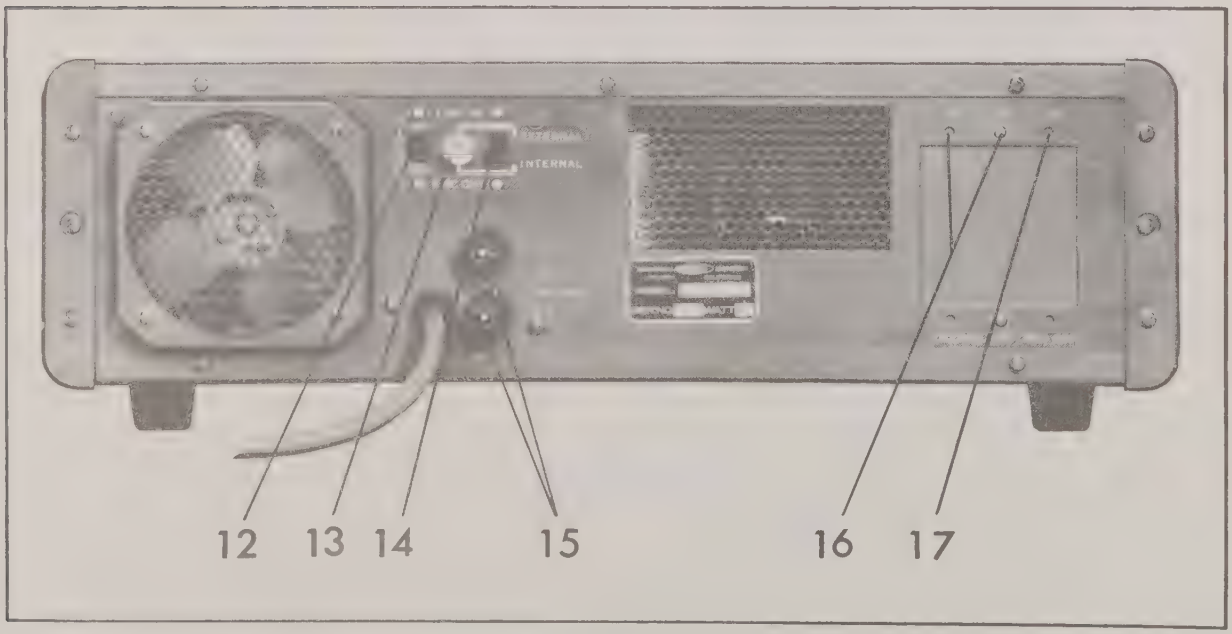



FIGURE 3-3 REAR-PANEL SD 1037 COUNTER TIMER

TABLE 3-1

DESCRIPTION - FRONT AND REAR PANEL SD 1037

<table>
<tr><th>FIGURE</th><th>INDEX</th><th>NAME</th><th>FUNCTION</th></tr>
<tr><td>3-2</td><td>1</td><td>POWER switch</td><td>When set in the down position, power is removed from all circuits except the internal standard oscillator. If a high-stability oscillator option is installed, power is removed from all circuits. When set to the ON position, power is applied to all circuits.</td></tr>
<tr><td>3-2</td><td>2</td><td>T.B. OUT Connector</td><td>Supplied 6V p-p rectangular pulse from 470Ω output impedance. Period of the signal is selected by the TIME BASE switch from 10s to $10^{-7}$s (0.1 Hz to 10.0 MHz). Supplies 6V p-p rectangular pulse from 470Ω output impedance that is scaled from the input signal applied to the 1 MC IN connector on the rear-panel when the rear-panel INTERNAL-EXTERNAL switch is set to EXTERNAL. The scaling factor is determined by the setting of the TIME BASE switch on the front panel.</td></tr>
<tr><td>3-2</td><td>3</td><td>RESET switch</td><td>Provides for manually resetting the count to zero and after a delay, the start of a new count.</td></tr>
<tr><td>3-2</td><td>4</td><td>GATE indicator</td><td>Illuminated during the measurement interval and off during the final count display interval. Provides a positive indication that the instrument is counting when the storage mode of display is used.</td></tr>
<tr><td>3-2</td><td>5</td><td>TIME BASE switch</td><td>Selects the gate time for frequency measurements; the number listed on the switch scale is the gate time in seconds.<br><br>Selects the scaling factor in the scaling mode of operation as follows:<br><br><table><tr><th>SWITCH POSITION</th><th>SCALING FACTOR</th></tr><tr><td>$10^{-6}$</td><td>1</td></tr><tr><td>$10^{-5}$</td><td>10</td></tr></table></td></tr>
</table>

| FIGURE | INDEX | NAME | FUNCTION | |
|---|---|---|---|---|
| | | | SWITCH POSITION | SCALING FACTOR |
| | | | $10^{-4}$ | 100 |
| | | | $10^{-3}$ | 1K |
| | | | $10^{-2}$ | 10K |
| | | | $10^{-1}$ | 100K |
| | | | 1 | 1M |
| | | | 10 | 10M |
| | | | $10^{-7}$ | N/A |
| | | | Provides averaging of ratio measurements in decade steps from 1 to 10M. Relation between TIME BASE switch position and ratios averaged same as in scaling mode of operation. Provides the frequency to be counted (and therefore the resolution) during period measurements. | |
| 3-2 | 6 | DISPLAY Control | Varies duration of the count display from approximately 0.1 to 5 seconds before the instrument is automatically reset for the next measurement cycle. In the extreme clockwise position, the display will remain until the reset button is depressed. | |
| 3-2 | 7 | FUNCTION Switch | Selects RATE (frequency), TEST, RATIO, and PERIOD functions in conjunction with the RANGE and TIME BASE switch as follows: | |

| Function Switch Position | Time Base Switch Position | Range Switch Position | Mode |
|---|---|---|---|
| TEST | 10 to $10^{-6}$ | | Self-Test; measures and displays 10 MHz test signal. |
| RATE C | 10 to $10^{-6}$ | 1,10,100 | Frequency measurement of input signal at INPUT C connector on front-panel. |
| RATE C | 10 to $10^{-6}$ | HET | Frequency measurement of output signal from plug-in unit. |
| COUNT C | N/A | 1,10,100 | Totalized number of cycles applied to INPUT C Connector |
| HOLD | N/A | N/A | Turns gate OFF manually |

| Function Switch Position | Time Base Switch Position | Range Switch Position | Mode |
|---|---|---|---|
| TIME B/A | 10 to $10^{-7}$ | N/A | Function available only with SD 1924 or SD 1926A plug-ins. Measures time interval between signals applied to A and B inputs of these plug-ins with resolution determined by setting of TIME BASE switch. |
| PER A | 10 to $10^{-7}$ | 1,10,100 | Measures period of one cycle of input waveform applied to INPUT C connector, (or, if used, to A input of SD 1924 or SD 1926A plug-ins). Resolution determined by setting of TIME BASE switch. |
| PER A x 10 | 10 to $10^{-7}$ | 1,10,100 | Same as PER A but measures 10 cycles of input waveform. |
| PER A x 100 | 10 to $10^{-7}$ | 1,10,100 | Same as PER A but measures 100 cycles of input waveform. |
| RATIO C/A | N/A | 1,10,100 | Function available only with SD 1924 or SD 1926A plug-ins. Counts number of cycles at INPUT C connector during one cycle at A input of plug-in. |
| RATIO C/A x 10 | N/A | 1,10,100 | Same as RATIO C/A except counts number of cycles at INPUT C connector during 10 cycles at A input of plug-in. |
| RATIO C/B-A | N/A | 1,10,100 | Function available only with SD 1924 or SD 1926A plug-ins. Counts number of cycles at INPUT C connector during time interval between A and B inputs of plug-in. |

| FIGURE | INDEX | NAME | FUNCTION |
|---|---|---|---|
| 3-2 | 8 | RANGE switch | Selects source of input signal and provides three ranges of input attenuation. In the 1,10, and 100 positions, the signal at the INPUT C connector on the front-panel is attenuated in decade steps and applied to the signal processing circuits. |

| FIGURE | INDEX | NAME | FUNCTION |
|---|---|---|---|
| | | | In the HET position, the output signal from the plug-in unit is applied to the signal processing circuits through a fixed attenuator. |
| 3-2 | 9 | LEVEL control | Adjusts the trigger level of the signal processing circuits between approximately +1.0V and -1.0V with reference to the attenuated signal input. With reference to the unattenuated signal applied to the INPUT C connector, the trigger level is equal to the product of the selected attenuation factor and the trigger level voltage set by the LEVEL control. |
| 3-2 | 10 | AC-DC switch | Permits the choice of AC or DC coupling of the signal at the INPUT connector. In the DC position, output pulses will be produced when the instantaneous DC + AC level of input voltage exceeds the triggering level. In the AC position, the DC component is removed and the instantaneous value of the AC component triggers the circuit. |
| 3-2 | 11 | INPUT C connector | Accepts an external signal for frequency or ratio measurement. In ratio measurement the signal serves as the numerator ($f_1$). |
| 3-3 | 12 | STORAGE switch | In the OFF position, it defeats the storage function permitting the operator to observe the counting cycle; in the ON position it provides for a continuous display of the most recent measurement. |
| 3-3 | 13 | 1 MC IN-OUT connector | When the EXTERNAL-INTERNAL switch is in the EXTERNAL position it provides the input connection for external 1 MHz standard oscillator; the denominator frequency ($f_2$) in the ratio measurement mode; and the input signal in the scaling mode. With the EXTERNAL-INTERNAL switch set to INTERNAL, it provides the output connection for the funda- |

| FIGURE | INDEX | NAME | FUNCTION |
|---|---|---|---|
| | | | mental (1 MHz) output of the internal standard oscillator. |
| 3-3 | 14 | EXTERNAL-INTERNAL switch | In the EXTERNAL position, it switches the input of the Time Base section to the 1 MC IN connector. |
| 3-3 | 15 | F-1, F-2 | Primary Power Line Fuses. |
| 3-3 | 16 | J-4, J-5 | |
| 3-3 | 17 | J-6 | D1, D2 Option Connector. Connector location for connecting instrument to digital printer. |

## 3.3 PREPARATION FOR USE

After familiarization with the operating controls, connectors and indicators listed in Table 3-1, the operator should then review the voltage input requirements in Table 3-2 and then perform the initial turn-on and test function given in Table 3-3. The voltage amplitude of signals connected to the input connectors of the instrument must be within the limits given in Table 3-2 to prevent damage to the instrument and to obtain the specified accuracy of measurement.

TABLE 3-2

VOLTAGE INPUT AND OUTPUT LEVELS

| CONNECTOR | FIGURE | INDEX | RANGE | | | |
|---|---|---|---|---|---|---|
| | | | RANGE switch | AC-DC switch | Minimum | Maximum |
| INPUT C | 3-2 | 11 | 1 | DC | 0.3V p-p | 10.0V p-p |
| | | | 10 | DC | 3.0V p-p | 50.0V p-p |
| | | | 100 | DC | 30.0V p-p | 150.0V p-p |
| | | | | AC | AC levels same as above; DC limited to ±500V. | |
| 1 MC IN | 3-3 | 13 | 3.0V p-p minimum; 6.0V p-p maximum; 1000 Ω input Z; (Scaling and external standard modes). | | | |
| 1 MC OUT | 3-3 | 13 | 1 MHz, 3.0V p-p minimum available in all modes when INTERNAL-EXTERNAL switch is set to INTERNAL. 470 Ω Z. | | | |
| T.B. OUT | 3-2 | 2 | 6.0V p-p minimum, 470 Ω Z. Frequency determined by mode of operation. | | | |

TABLE 3-3

INITIAL TURN-ON AND TEST PROCEDURE

| STEP | ACTION | INDICATION |
|---|---|---|
| 1 | Install Blank or Compatible Plug-in Unit:<br>a) Turn locking knob located at the left of the plug-in receptacle at least two turns counter-clockwise.<br>b) Insert blank plug-in (or compatible plug-in from Table 3-4) into the receptacle, pushing it until it is flush with the instruments front panel.<br>c) Lock the plug-in in place by turning the locking knob clockwise until tight. | |
| 2 | Initial Control Settings:<br>a) POWER switch to the down (OFF) position.<br>b) Rear-panel EXTERNAL-INTERNAL switch to INTERNAL.<br>c) RANGE switch to "1" position.<br>d) FUNCTION to TEST position.<br>e) TIME BASE switch to "$10^{-6}$" position.<br>f) Rear-Panel STORAGE ON-OFF to ON.<br>g) LEVEL control to "0".<br>h) DISPLAY control fully counter-clockwise. | |
| 3 | Perform Test Function:<br>a) Plug instrument line cord into 50-60 Hz, 115V source.<br>b) Turn POWER switch to ON position. | 1) Fan operates (rear-panel).<br>2) ON lamp illuminates.<br>3) GATE lamp illuminates. |

| STEP | ACTION | INDICATION |
|---|---|---|

*NOTE: IF AN ABNORMAL INDICATION IS PRESENT IN THIS OR SUBSEQUENT STEPS, IMMEDIATELY TURN THE POWER SWITCH TO THE OFF POSITION, UNPLUG THE INSTRUMENT FROM THE POWER SOURCE AND REFER TO CHAPTER 4, TROUBLESHOOTING.*

c) Allow 45-minute warm-up

*NOTE: FOR INITIAL INSTALLATION, ALLOW 72 HOURS (48 HOURS FOR B, B4 OPTION) FOR INTERNAL OSCILLATOR TO REACH SPECIFIED AGING RATE. FOR MAXIMUM STABILITY OF MEASUREMENT, INSTRUMENT SHOULD REMAIN PLUGGED-IN TO PRIMARY POWER SOURCE (PLUGGED-IN AND TURNED ON IF B, B3, OR B4 INTERNAL OSCILLATOR OPTION IS INSTALLED).*

d) Test Signal Gate, Time Base, Counter, and Internal Standard functional sections. Rotate the TIME BASE switch through all positions and check for indications given at right.

| TIME BASE switch | Correct Indication (±1 count tolerance) |
|---|---|
| $10^{-7}$ | (indication not valid) * |
| $10^{-6}$ | 00000010. MHz |
| $10^{-5}$ | 0000010.0 MHz |
| $10^{-4}$ | 000010.00 MHz |
| $10^{-3}$ | 00010.000 MHz |
| $10^{-2}$ | 0010000.0 kHz |
| $10^{-1}$ | 010000.00 kHz |
| 1 | 10000.000 kHz |
| 10 | (1) 0000.0000 kHz |

e) Test Signal Processor functional section. Set TIME BASE switch to the $10^{-1}$ position and FUNCTION switch to RATE C. Connect a length of 50 Ω coax (SD 10338) between the 1 MC OUT connector on the rear-panel and the INPUT connector on the front panel. Adjust LEVEL control as necessary to give stable count.

1) Instrument display indicates: 0010000.00 kHz

f) Disconnect the 50Ω coax (SD 10338) from the rear-panel connector. The instrument is now ready for use.

TABLE 3-4

COMPATIBLE PLUG-IN UNITS

| MODEL | NAME | FUNCTION |
|---|---|---|
| 1253 | ACTO, 300-3000 MHz | Automatic Frequency Extender |
| 1255A | ACTO, 3.0-12.4 GHz | Automatic Frequency Extender |
| 1257 | ACTO, 12-18 GHz | Automatic Frequency Extender, ±12% of specified center frequency |
| 1291 | 512 MHz Heterodyne Converter | Extend frequency range |
| 1292 | 15 GHz Transfer Oscillator | Extend frequency range |
| 1295 | 3.0 GHz Heterodyne Converter | Extend frequency range |
| 1297 | 26 GHz Transfer Oscillator | Extend frequency range |
| 1979A | 100 MHz Prescaler | Extend frequency range |
| 1979H | 350 MHz Prescaler | Extend frequency range |
| 1936 | Integrating Digital Voltmeter | DC voltage measurements |
| 1944A | Preset | Measurement in preset engineering unit |
| 1948A | Video Amplifier | Increase sensitivity to 1.0 mV |
| 300 | Plug-in Expander | Permits interconnection of 3 Plug-ins to one frequency meter of counter-timer |
| 1924 | Dual Measurement | Measures any two frequencies or periods alternately with automatic switching |
| 1926A | Time Interval Measurement | Measure pulse width, spacing or time between electrical events. |

## 3.4 MEASUREMENT PROCEDURES

Tables 3-5, 3-6, 3-7, 3-8 and 3-9 give the procedures for frequency, ratio, scaling, counting, and period measurement modes of operation. Procedures requiring a compatible plug-in unit are not provided; refer to the appropriate technical manual for the plug-in involved. If the operator is not familiar with digital measurement techniques, a review of paragraph 3-5 and 3-6 is recommended.

TABLE 3-5

FREQUENCY MEASUREMENT

| STEP | ACTION | REMARKS |
|---|---|---|
| 1 | Perform the turn-on and test procedure given in Table 3-3 | |
| 2 | Set the TIME BASE switch for the desired resolution | |

| STEP | ACTION | REMARKS |
|---|---|---|

| TIME BASE switch | RESOLUTION |
|---|---|
| $10^{-6}$ | 1 MHz |
| $10^{-5}$ | 100 kHz |
| $10^{-4}$ | 10 kHz |
| $10^{-3}$ | 1 kHz |
| $10^{-2}$ | 100 Hz |
| $10^{-1}$ | 10 Hz |
| 1 | 1 Hz |
| 10 | 0.1 Hz |

| STEP | ACTION | REMARKS |
|---|---|---|
| 3 | Check that the rear-panel EXTERNAL-INTERNAL switch is set to INTERNAL | |
| 4 | Set the STORAGE ON-OFF switch as desired | 1) In the ON position, a continuous display of the most recent measurement is provided.<br>2) In the OFF position, cycling of the counting decades is displayed. |
| 5 | Set DISPLAY control as desired | 1) 0.1 to 5.0 second count display before initiating next measurement cycle. |
| 6 | Set RANGE switch as follows:<br>a) If amplitude of input signal is known, set RANGE switch in accordance with table at right.<br><br>b) If amplitude is unknown, set the range switch to 100 and proceed to step 7. | |

| INPUT Amplitude | RANGE Switch Position |
|---|---|
| 0.3 - 3.0 V p-p | 1 |
| 3.0 - 30 V p-p | 10 |
| 30 - 150 V p-p | 100 |

*CAUTION: THE INSTRUMENT WILL NOT OPERATE PROPERLY WITH INPUT SIGNALS ABOVE 150 V PEAK-TO-PEAK.*

| STEP | ACTION | REMARKS |
|---|---|---|
| 7 | Set the AC-DC switch as desired | 1) The AC position is ordinarily used where the DC level of the external circuit is of the same order of magnitude or greater than the AC signal and is valid for AC signals down to 10 Hz. |
| *CAUTION: THE DC LEVEL MUST NOT EXCEED ±500 V IN THE AC POSITION.* | | |
| 8 | Apply the signal to be measured to the INPUT C connector. | |
| 9 | Rotate the LEVEL control until a stable count is observed. If no count is observed, place the RANGE switch in the next lower position and re-adjust the LEVEL control until a stable count is obtained. | |
| 10 | After stable count is achieved, continue to rotate LEVEL control until count ceases. Back-off LEVEL control setting to mid-point between the "start count" and "stop count" limits. | |

TABLE 3-6

RATIO MEASUREMENT ($f_2/f_1$)

| STEP | ACTION | REMARKS |
|---|---|---|
| 1 | Make all initial control settings and adjustments for frequency measurement | 1) See Table 3-5 |
| 2 | Connect higher frequency ($f_2$) to INPUT C connector on front panel. Adjust LEVEL and RANGE controls for stable count. | 1) Display indicates frequency of $f_1$ |
| 3 | Set rear-panel EXTERNAL-INTERNAL switch to EXTERNAL | |

| STEP | ACTION | REMARKS |
|---|---|---|
| 4 | Check that lower frequency ($f_1$) signal is within limits tabulated at the right. | 1) 10 kHz to 2 MHz<br>2) 3.0 V p-p minimum amplitude<br>3) 6.0 V p-p maximum amplitude |
| 5 | Connect lower frequency ($f_1$) to 1 MC IN rear panel connector. Display of the ratio $f_2/f_1$ will be as shown in the table at the right. | |

| TIME BASE | RATIO | RATIOS AVERAGED |
|---|---|---|
| $10^{-6}$ | Direct | 1 |
| $10^{-5}$ | Direct | 10 |
| $10^{-4}$ | Direct | 100 |
| $10^{-3}$ | Direct | $10^3$ |
| $10^{-2}$ | Ratio x $10^3$ | $10^4$ |
| $10^{-1}$ | Ratio x $10^3$ | $10^5$ |
| 1 | Ratio x $10^3$ | $10^6$ |
| 10 | Ratio x $10^3$ | $10^7$ |

TABLE 3-7

SCALING

| STEP | ACTION | REMARKS |
|---|---|---|
| 1 | Place the rear-panel EXTERNAL-INTERNAL switch in the EXTERNAL position | |
| 2 | Check that input frequency to be scaled is within limits tabulated in Step 4 of Table 3-6 | |
| 3 | Connect input signal to 1 MHz IN connector on rear-panel | |
| 4 | The scaled signal may be taken from the T.B. OUT connector on the front panel and has the characteristics shown at the right | 1) Amplitude: 6.0 V p-p minimum<br>2) Impedance: 470 Ω |

| STEP | ACTION | REMARKS | |
|---|---|---|---|
| | | 3) Frequency: 10 kHz to 2 MHz | |
| | | TIME BASE | T.B. OUT |
| | | $10^{-6}$ | $f_1$ |
| | | $10^{-5}$ | $f_1/10$ |
| | | $10^{-4}$ | $f_1/100$ |
| | | $10^{-3}$ | $f_1/10^3$ |
| | | $10^{-2}$ | $f_1/10^4$ |
| | | $10^{-1}$ | $f_1/10^5$ |
| | | 1 | $f_1/10^6$ |
| | | 10 | $f_1/10^7$ |
| | | $10^{-}$ | N/A |

TABLE 3-8

COUNT (TOTALIZING)

| STEP | ACTION | REMARKS |
|---|---|---|
| 1 | Perform the turn-on and test procedure given in Table 3-3 | |
| 2 | Check that the rear-panel EXTERNAL switch is set to INTERNAL | |
| 3 | Set RANGE switch | See Table 3-5 Step 6 |
| 4 | Set AC-DC switch | See Table 3-5 Step 7 |
| 5 | Place the FUNCTION switch to COUNT C position | |
| 6 | Apply signal to be counted to C INPUT connector | |
| 7 | Adjust LEVEL control | See Table 3-5 Steps 9 and 10 |
| 8 | Place FUNCTION switch to HOLD position and push RESET button | |
| 9 | Start count at desired time by returning FUNCTION switch to COUNT C position | |

| STEP | ACTION | REMARKS |
|---|---|---|
| 10 | Stop count at desired time by placing FUNCTION switch to HOLD position | Counter may be cleared by manually depressing RESET button |

TABLE 3-9

PERIOD MEASUREMENT

| STEP | ACTION | REMARKS |
|---|---|---|
| 1 | Perform the turn-on and test procedure | See Table 3-3 |
| 2 | Perform the frequency measurement procedure | See Table 3-5 |
| 3 | Set the TIME BASE switch for the desired resolution (weight or least significant digit in display) | TIME BASE switch position / RESOLUTION<br>$10^{-7}$ — 0.1 µs<br>$10^{-6}$ — 1.0 µs<br>$10^{-5}$ — 10 µs<br>$10^{-4}$ — 100 µs<br>$10^{-3}$ — 1 ms<br>$10^{-2}$ — 10 ms<br>1 — 1 s<br>10 — 10 s |
| 4 | Set the FUNCTION switch to the PER A position | Display indicates time of one cycle of signal at INPUT C connector.<br><br>To obtain greater accuracy, the multiple period averaging (PER A x 10 and PER A x 100 positions of FUNCTION switch) mode may be used. Display still indicates time of one cycle but is averaged over 10 cycles or 100 cycles of the input signal.<br><br>A non-valid indication (*) will appear on the annunciator in the PER x 10 function for a "10" setting of the TIME BASE and in the PER x 100 function for a "10" and "1" setting of the TIME BASE switch. This is because the dividers |

| STEP | ACTION | REMARKS |
|---|---|---|
| | | used to obtain these time base periods are being used to divide the input signal. |

## 3.5 ACCURACY OF MEASUREMENTS

### A. Gating Ambiguity

All types of digital measuring instruments are subject to an irreducible ±1 count ambiguity in the least significant digit of the display. This error is possible because the signal counted is not coherent (synchronized) with the time base pulses that control the signal gate. As illustrated in Figure 3-4, the first or last cycle of the input signal may or may not pass through the signal gate during the selected measurement interval.

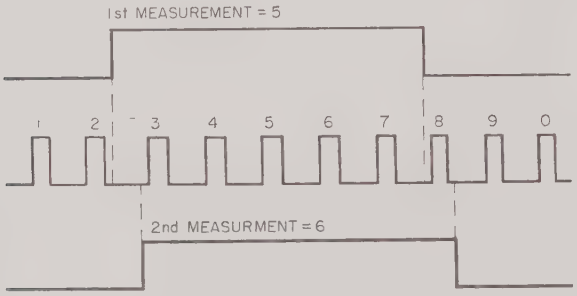



**FIGURE 3-4** Gating Ambiguity

As the frequency measured is increased, the % of error due to the ±1 count ambiguity is reduced because it becomes less significant compared to the total count. In any case, the maximum percentage of error is a function of the frequency measured and the number of pulses counted, i.e., the time base selected, and may be expressed by:

$$\text{Max \% error} = \pm \frac{1}{f \times T} \times 100 \leq 100\%$$

where: f is the frequency measured in Hz and T is the selected time base in seconds. Thus to measure 1 MHz with a ±0.001% maximum gating error, the time base switch must be set to $10^{-1}$ position.

### B. Internal Oscillator Stability

The gating precision and therefore the accuracy of the count is dependent upon the stability of the internal oscillator. In the standard SD 1037, the oscillator is initially set to within ± 1 part in $10^9$ of a 1 MHz frequency standard having at least an order of magnitude higher stability. The deviation of the SD 1037 oscillator from this frequency then becomes a function of several factors; ths most significant being time. Due to certain processes in the frequency determining elements of the oscillator, an "aging" rate will be established that is measured and specified for the oscillator. For the Standard SD 1037 the specified aging rate is less than 5 parts in $10^8$ per day after an initial warm-up of 72 hours. Generally this aging rate decreases somewhat with time (providing the instrument is plugged in and turned ON), but the error due to oscillator instability may be estimated from:

$$\text{Max \% error} = (\pm 5/10^8 \times D) \times 100$$

where: D is the number of days since last calibrated.

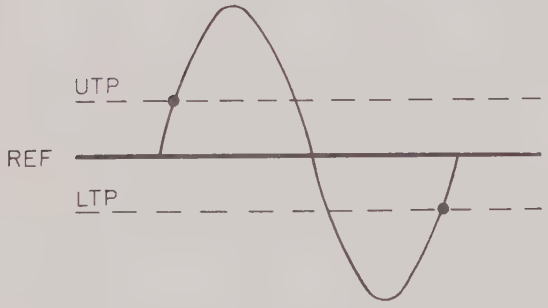
Oscillator stability is also a function of line voltage and temperature but, except for the time immediately after calibration, their effect will be several orders of magnitude less than the effect of aging and may be neglected. To achieve

the highest accuracy of measurement, the following considerations apply:

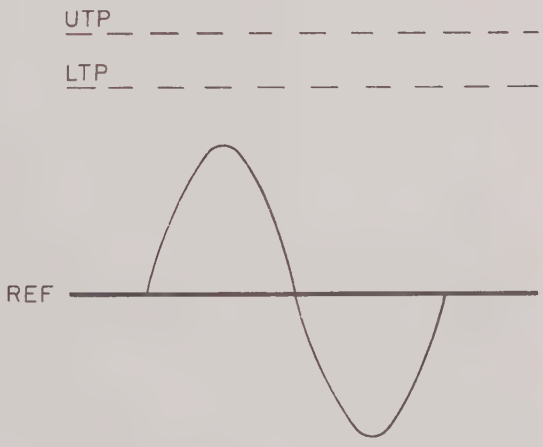
1) Maintain the instrument plugged-in and turned on.
2) Maintain constant environmental conditions.
3) Monitor or regulate line voltage.
4) Calibrate instrument at intervals consistent with maximum allowable error.

C. Level Control Adjustment

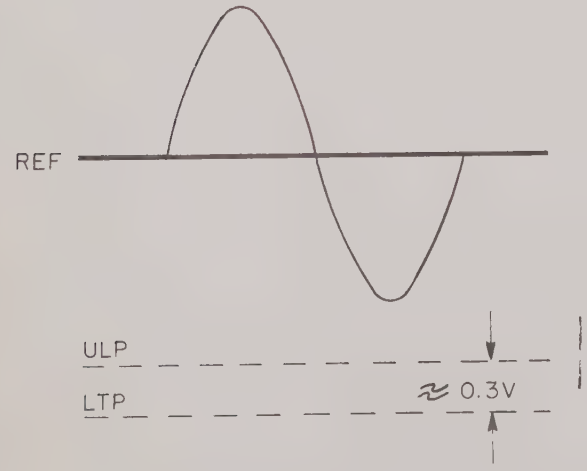
Unstable and inaccurate measurements are often the result of inconsistent triggering of the signal processor circuits. This is most often due to improper adjustment of the LEVEL control for the type of signal being handled. Figure 3-5 illustrates the nominal input triggering level and the effect of the LEVEL control. Note that there is a 0.3V nominal seperation (or hysterisis) between the upper and lower trigger levels and in operation, the input signal must cross both levels to complete a triggering cycle. The LEVEL control acts to offset the reference level of the input signal.




a. LEVEL set to "0"




b. LEVEL set to "-"




c. LEVEL set to "+"

**FIGURE 3-5** TRIGGER LEVEL

Generally, the setting of the LEVEL control for sinusoidal inputs should be made at approximately the center of the steepest slope of the input waveform to ensure reliable counting. However careful attention must be paid to the amplitude shape of the input signal when non-sinusoidal, unknown, or marginal signals are the case. It is recommended that an oscilloscope be utilized for signal analysis under these conditions. Figure 3-6 illustrates a variety of situations leading to inaccurate counting and some possible solutions.

FIGURE 3-6 Effect of Signal Shape on Triggering

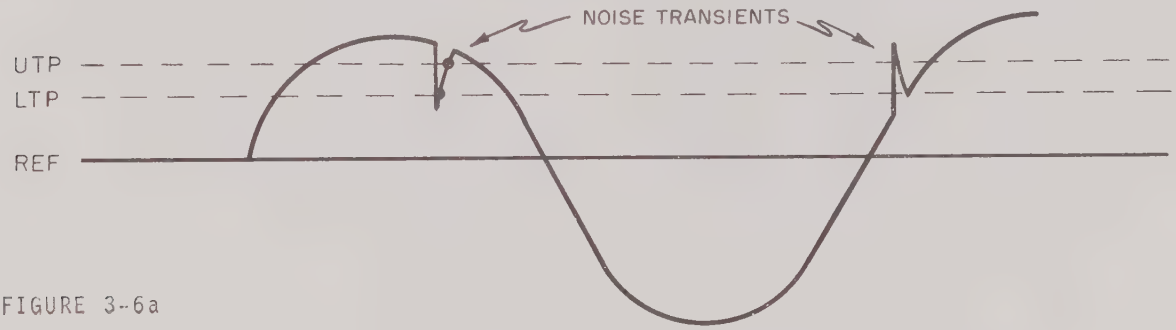



FIGURE 3-6a

A. **Problem:** Spurious counts from superimposed noise transient of sufficient amplitude to cross trigger levels.

**Possible Solutions:**

1) Adjust LEVEL control for triggering on steepest portion of signal slope.

2) Provide attenuation (either internal or external) to reduce noise peaks below trigger hysterisis (0.3V).

3) Connect LP filter between signal source and instrument input.

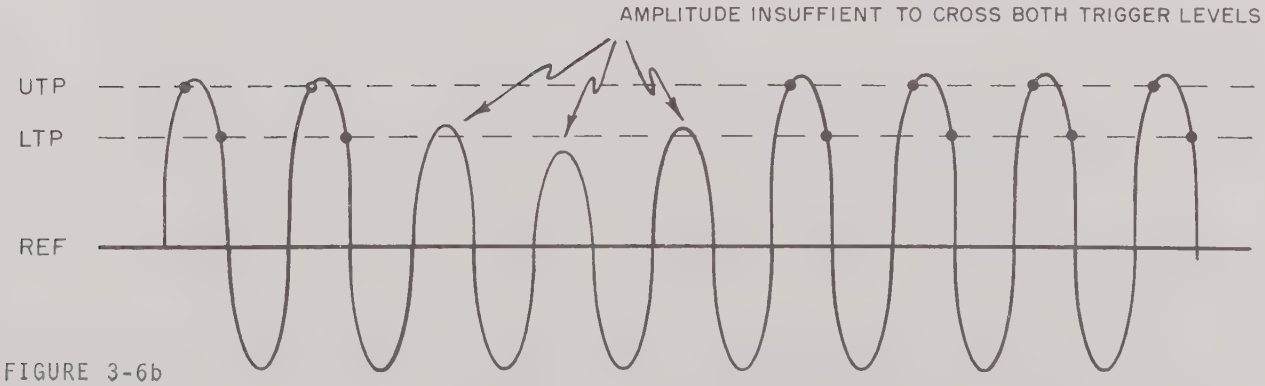



FIGURE 3-6b

B. **Problem:** Missing count due to amplitude modulation of input signal.

**Possible Solution:** Adjust LEVEL control for triggering on steepest slope. Signal amplitude in modulation trough must be sufficient to cross both trigger levels.

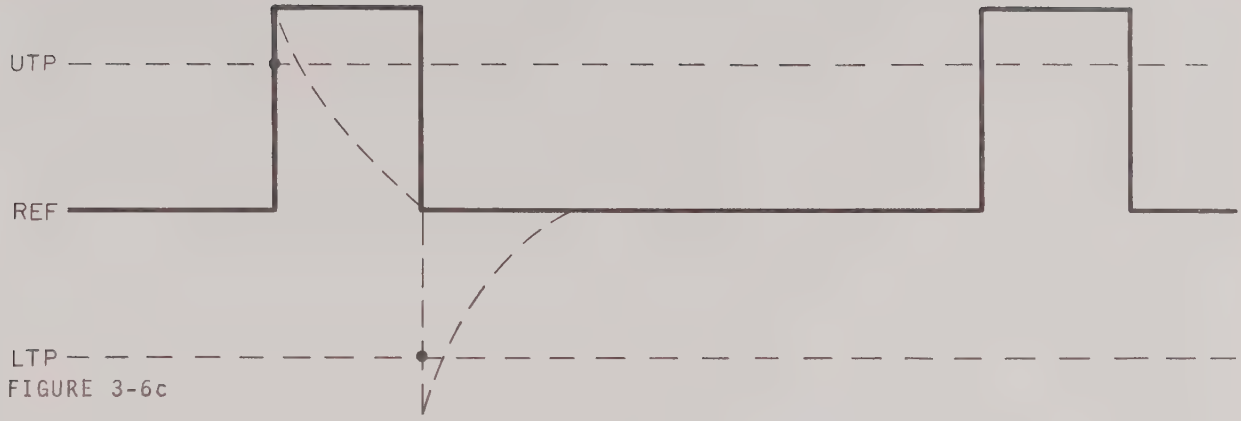


FIGURE 3-6c

C. **Problem:** Monopolar pulses intersect only one triggering level.

**Possible Solutions:**

1) Offset LEVEL control so that pulse intersects both levels. Pulse amplitude must be greater than hysterisis value (0.3V).

2) Externally differentiate pulses.

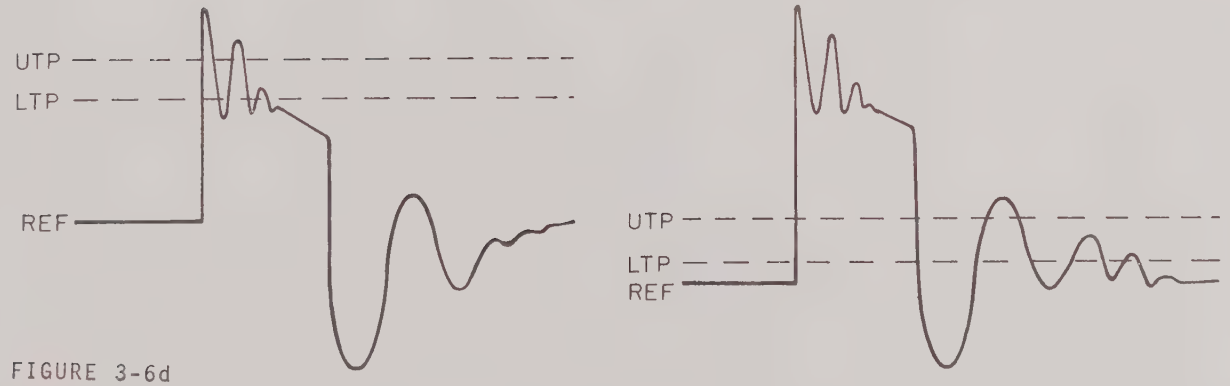


FIGURE 3-6d

D. **Problem:** Ringing on leading and trailing edges of signal pulse. Usually a result of mismatch between instrument input and signal source when source is 50 or 75 Ω.

**Possible Solution:** Properly terminate input signal cable at INPUT connector on front-panel of instrument (usually a 50 or 75 Ω termination in shunt with INPUT).

## D. Period Measurements

For high frequency measurements, the ±1 count gating error is insignificant compared to the total count. At low frequencies, however, the error may become important. For this reason the period mode of measurement is normally used to obtain greater accuracy. Figure 3-7 shows which type of measurement will yield the lowest gating error.

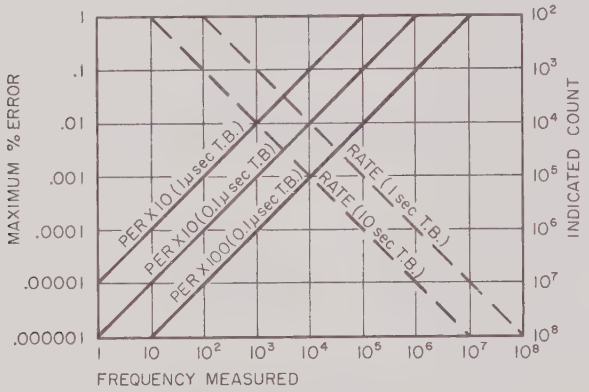



**FIGURE 3-7**

Accuracy of Period vs. Rate Measurements

Gating error can be reduced by a factor of 10 by extending the interval of measurement (Period X10, etc.). The total count is multiplied by 10 but the gating error remains ±1 count. Longer timing intervals may be provided automatically or by manual control using the "count" mode.

For example, if a 10 kHz signal is measured over a 0.1 second time base, the count indicated would be 1000 ±1 and the percentage of error would be ±0.1%. Measured over a 1 second time base, the count indicated would be 10000 ±1 and the percentage of error would be reduced to ±0.01%.

Period and related time interval measurements are subject to a trigger time error caused by noise on the input signal. The total signal may be considered as an ideal noise-free signal with a super-imposed noise signal. The noise, added to the ideal signal, may trigger the channel before or after the selected instant for triggering. The maximum error in time for a given peak-to-peak noise voltage ($V_n$) and the slope of the ideal signal at the trigger level is:

$$t\ (\text{sec}) = \frac{Vn \quad (\text{volts})}{\text{Slope} \quad (\text{volts/sec})}$$

The maximum percent error is:

$$\text{Max. \% error} = \frac{t \times 100 \quad (\text{sec})}{T \quad (\text{sec})}$$

For a sine wave triggering at its zero cross-over point:

$$\text{Max. \% error} \pm \frac{Vn \times 100 \quad (\text{volts})}{Vs \quad (\text{volts})}$$

This error effectively lengthens or shortens the period measurement, as depicted in Figure 3-8. The percentage of error is given by the formula 100 ÷ T where T is the actual period and "t" is the trigger error (in seconds).

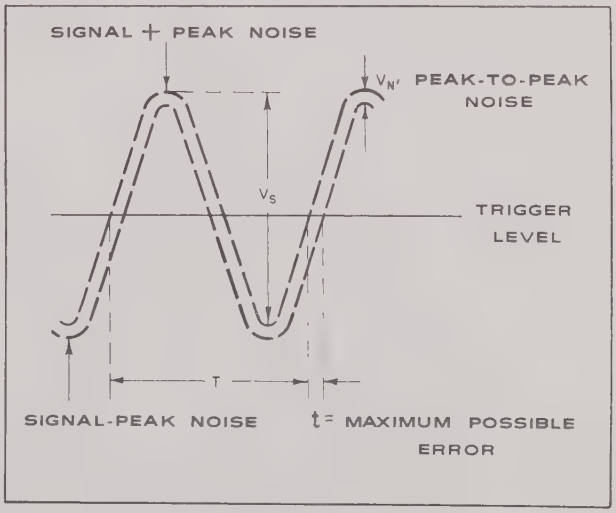



**FIGURE 3-8**

HOW NOISE PRODUCES TRIGGERING ERROR

From the foregoing discussion, it can be seen that as the amplitude of signal voltage is increased, the percentage of error is diminished. In addition, if the trigger level is set at the center of the steepest slope of the waveform, the maximum error will be reduced.

## 3.6 APPLICATIONS

SD 1037 Counter can be employed for measurement, analysis, and counting of both periodic and random signal pulses of arbitrary waveshape within the rated frequency characteristics of the instrument. Because it operates directly from voltage inputs, it is an indispensable tool for designing, manufacturing, and testing of instruments and circuits having an electrical output relating to time interval, frequency, and number of occurrences. It is commonly used for the design and calibration of transmitting and receiving equipment, oscillators, tuned circuits, crystals, etc. Because of its accuracy and stability, it is invaluable for checking long-term drift and heat-cycling stability of crystals and other signal generators. Other common applications are calibration of resolvers and synchros, and measuring gain-phase characteristics of closed loop servo systems.

When employed with suitable input transducers, such as photo cells, magnetic pickups, or switches, it becomes equally valuable for measuring physical events with respect to time, for example: speed of rotation, flow rate, time delays, or production unit counting. A list of typical applications includes: frequency measurements; relay and switch timing; viscosity and ballistic measurements; elasticity measurements; tchometry; telemetry; pulse height and width analysis; oscilloscope time base calibration; flow, strain, force, pressure measurements; radiation counters.

## 3.7 OPERATORS MAINTENANCE

No special or preventative maintenance procedures are required. Troubleshooting and corrective maintenance should be performed only be persons having the appropriate technical skill and experience in digital techniques. Refer to Chapter 4 for troubleshooting and to Chapter 5 for maintenance procedures.

# CHAPTER 4

# TROUBLESHOOTING

## 4.1 OVERALL FUNCTIONAL DESCRIPTION

### A. General

The instrument is composed of four basic elements: an input amplifier, a time base circuit, a switching circuit, and a counting circuit. Changing the relationship of these basic elements with the FUNCTION switch enables the instrument to perform its various functions. In addition, use of the interchangeable plug-ins (see Table 1-2) increases the flexibility of the input circuitry.

The basic instrument is capable of counting, and of performing rate and period measurements. With some limitations, the counter can also perform ratio measurements and input signal decade scaling. This chapter describes the basic counter elements, their interconnection to perform these functions, and the trouble-shooting procedures.

### B. Basic Circuits

Shaping and amplification of the input signal are accomplished by the input amplifier. The front panel controls for C-input coupling (AC/DC switch, RANGE switch and trigger LEVEL control) all connect to this amplifier. Outputs from the amplifier feed the switching circuit as either "count" or "start/stop" signals, depending on the operation being performed. When certain of the interchangeable plug-ins are used in the counter, the functions of the input amplifier are performed by the plug-in.

The time base provides the precise frequencies needed for rate and period measurements. Both multiplier and divider circuits process the output of a crystal oscillator to provide the frequencies required by the counter. The front-panel TIME BASE and FUNCTION switches determine the disposition of these frequencies. Outputs from the time base are sent to the switching circuit as either "count" or "start/stop" signals, and in some cases, to the installed plug-in. A switch and jack on the rear-panel permit the use of an external oscillator. The T.B. OUT jack on the front-panel allows access to the selected scaled output of the time base or external oscillator input.

The switching circuit regulates the passage of the trigger signal to the counting circuit. There are two elements in the switching circuit: a gate generator that receives "start/stop" signals and produces a control gate signal and an electronic switch that receives a "count" signal and produces the counting circuit trigger. The source of the "count" and "start/stop" signals is controlled by the front-panel FUNCTION switch. Front-panel indication of the condition of the switching circuit is provided by the GATE lamp which is on when the switch is closed.

The counting circuit is a chain of decades, or divide-by-ten elements, with their associated indicators and reset circuitry. Selection of decimal point

and annunciator are also functions of this circuit. The front-panel DISPLAY control and RESET button are associated with this circuit, as is the rear-panel STORAGE switch.

### C. Functions

The front-panel FUNCTION switch selects the six basic modes of operation and the TEST function as described in the following paragraphs.

*NOTE*

*Some interchangeable plug-ins preempt the input circuits, making use of the C INPUT impossible in some functions. Refer to the Operation Section of the plug-in manual and Chapter 3 of this manual for any operating limitations.*

#### 1. Count (totalize)

The instrument counts the number of cycles of a signal at the C INPUT during the arbitrary period of time that the FUNCTION switch is in the COUNT position. Refer to Figure 4-1. Switching to the HOLD position terminates the count, making the input manually controlled. There is no decimal point or unit indication in this function.

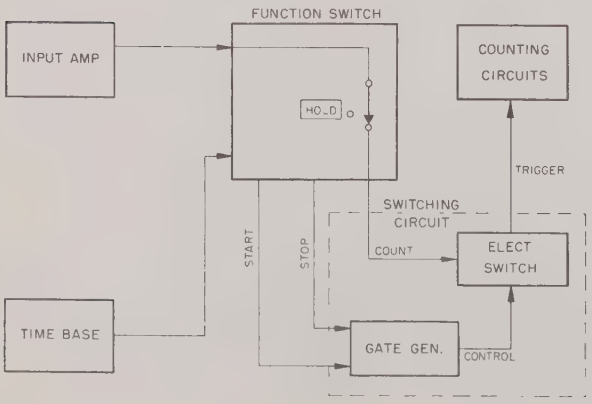



**FIGURE 4-1** Count (Totalize)

#### 2. Rate (Frequency) Measurement

The instrument counts the number of cycles of a signal at the C INPUT during a time period selected by the TIME BASE switch. Refer to Figure 4-2. Shaped and amplified pulses are produced by the input amplifier and counted between successive time base pulses. The counting period equals the number of seconds selected with the TIME BASE switch. Decimal point and unit (KHz or MHz) indication is provided in this function. (Asterisk indication in "$10^{-7}$" indicates high percentage of gating error).

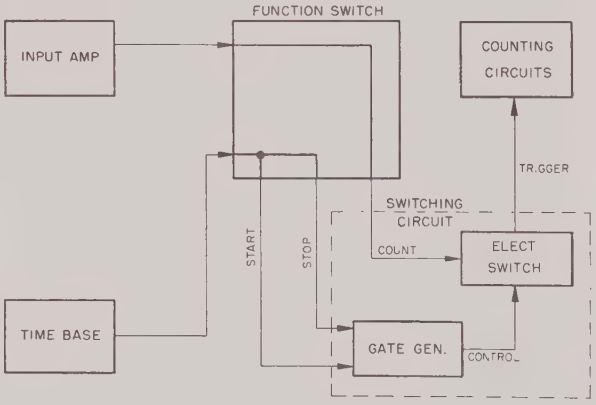



**FIGURE 4-2** Rate (Frequency) Measurement

#### 3. Period Measurement

The instrument counts the increments of time, selected by the TIME BASE switch, which occur during each cycle of the input signal. (If the installed plug-in has an "A" input, use of the C INPUT is preempted). Refer to Figure 4-3. Pulses from the time base, representing units of time, are counted between successive input pulses.

In the PER A x 10 position of the FUNCTION switch, a decade element (divide-by-ten circuit) is inserted in the input signal path. This element produces one output pulse for every ten input pulses. In the PER A x 100 position,

a second decade is inserted in the input signal path.

Decimal point and unit (S, mS, µS) indication is provided in this function. In the PER A function, a "1" TIME BASE setting gives a non-valid indication (asterisk annunciator) because the decimal point has effectively moved one digit past the end of the readout.

The non-valid indication in the other period functions (at the low time base rates) stems from the unavailability of decade elements. (The same decades that provide the low time base rates in other functions provide time period division in the PER functions).

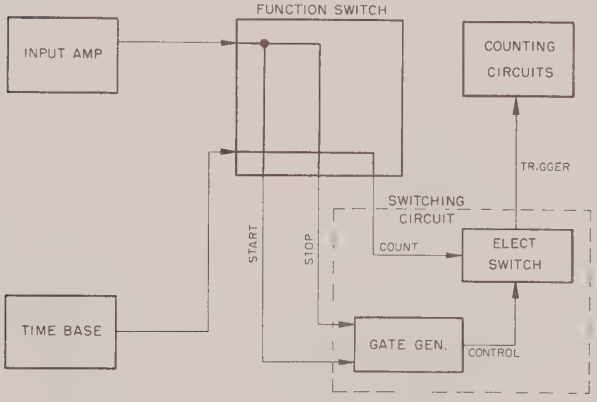



**FIGURE 4-3** Period Measurement

4. Time Interval Measurement

The instrument counts the increments of time selected by the TIME BASE switch, which occur between the event on the "A" channel and the event on the "B" channel. Refer to Figure 4-4. Controls on the plug-in permit use of one or two input signals as well as selection of triggering criteria. Decimal point and unit (S, mS, µS) indication are provided in this function. The non-valid indication (asterisk indicator lit) in the "10" position of the TIME BASE switch occurs for the same reason as given for PER A: The decimal point has effectively moved one digit past the end of the readout.

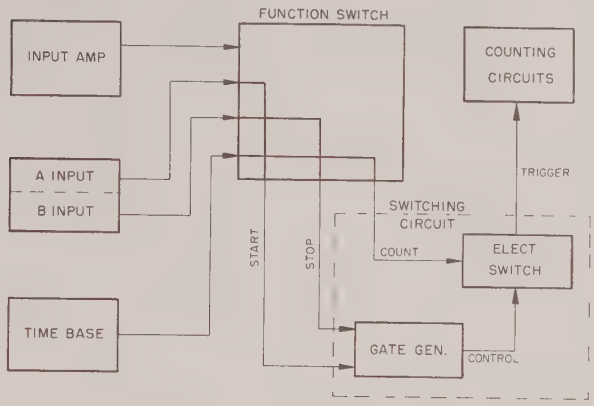



**FIGURE 4-4** Time Interval Measurement

5. Ratio Measurement

The instrument counts the number of cycles of the signal at the C INPUT that occur between two successive events at some other input. Ratio measurements can be performed using either the basic counter or a plug-in input. In either case, the signal possessing the higher of the two frequencies involved, should be attached to the C INPUT.

Ratio measurements using the basic counter are made with the FUNCTION switch in the RATE C position and the TIME BASE switch in the "$10^{-6}$" position. Refer to Figure 4-5a. The "start/stop" signal is fed through the oscillator IN/OUT jack on the rear-panel, with the accompanying switch in the EXTERNAL position. Decimal point and units indication should be disregarded when performing ratio measurements in the RATE function.

Ratio measurements using a plug-in with an "A" input channel are made with the FUNCTION switch in one of the RATIO $\frac{C}{A}$ positions. Refer to Figure 4-5b. The TIME BASE switch has no effect on the readout.

Multiple ratio operation (RATIO $\frac{C}{A}$ x 10, for example) is achieved by inserting decade elements (divide-by-ten circuits) in the "A" input signal path. Decimal point indication is provided in the RATIO functions; there is no unit indication.

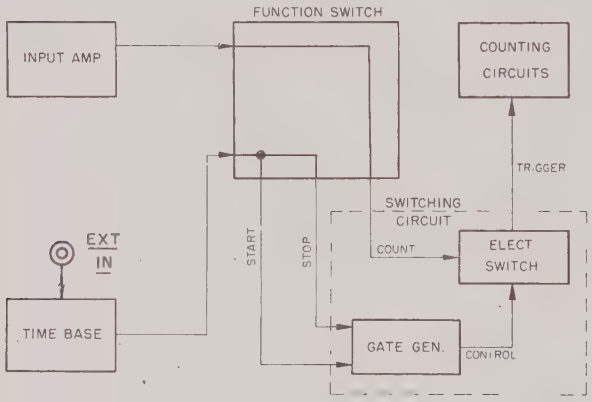



**FIGURE 4-5A** Basic Measurements

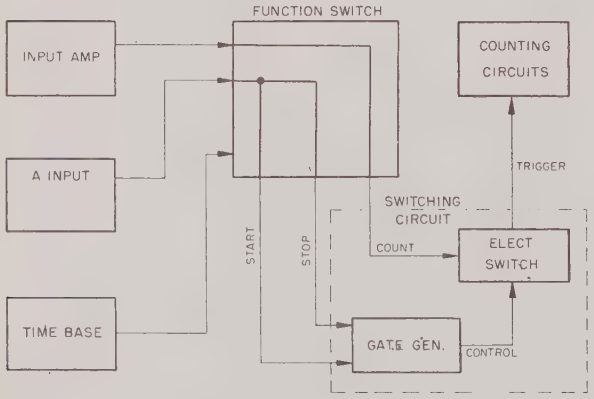



**FIGURE 4-5B** Plug-in Measurements

6. Gated Signal Counting

The instrument counts the number of cycles that occur in the signal at the C INPUT between an event on "A" input channel and an event on the "B" input channel. Refer to Figure 4-6. Controls on the plug-in permit the use of one or two input signals, as well as selection of triggering criteria. Decimal point indication is provided in this function; there is no unit indication.

7. Test Function

The instrument counts a 10 MHz signal from the time base for a period determined by the setting of the TIME BASE switch. Refer to Figure 4-7. Both decimal point and unit (KHz, MHz) indication are provided in this function.

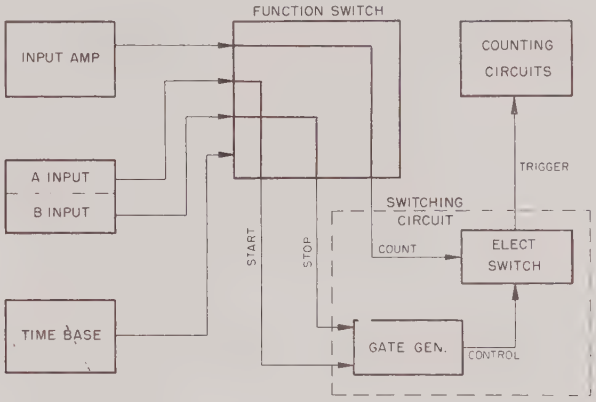



**FIGURE 4-6** Gated Signal Counting

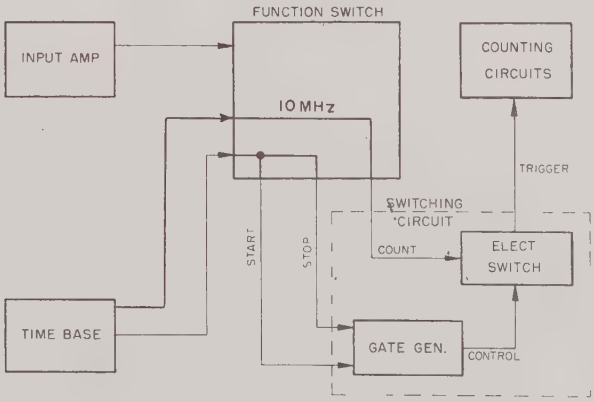



**FIGURE 4-7** Test Function

D. Functional Sections

Figure 4-18 is the overall functional block diagram of the instrument. The functional sections are:

1) 50 MHz Amplifier and Counter, Assembly 13534; Schematic 13531.
2) 50 MHz Readout Decoder, Assembly, 12979; Schematic 12978.
3) 10 MHz decade, Assembly 15200; Schematic 15201.

4) 2.5 MHz Decade, Assembly 11527; Schematic 11528
5) 250 kHz Decade, Assembly 11523; Schematic 11524.
6) Display and Reset, Assembly 19243; Schematic 19244.
7) Time Base Dividers, Assembly 15433; Schematic 15423.
8) Multiplier, Assembly 17966; Schematic 17970.
9) Power Supply, Assemblies 19681, 15670, 15401; Schematics 25344, 23478.
10) 1 MHz Oscillator, Assembly Y0023.
11) Annunciator, Assembly 15459 and switches S2-B, S2-E, S2-F.
12) Decimal Lamps, I8-I12 and Switch S1-A, S1-B, S1-C, S1-D.

## 4.2 OVERALL COUNTER TROUBLESHOOTING

The instrument is all solid-state and should provide long, trouble-free service. Apparent malfunction is sometimes due to the operator being unfamiliar with the instrument. It is wise to double check instrument connections and to review specifications to make sure operation is not being attempted beyond the capability of the instrument.

The Troubleshooting charts that follow are designed to lead maintenance personnel to a defective plug-in assembly or to a defective switch. The sections on each plug-in assembly contain troubleshooting procedures at the circuit level.

For the sake of brevity, several assumptions have been made in the logic charts. These assumptions are as follows:

A. That all power supply voltages are present and correct.

B. That the signal inputs to the counter are within specifications.

C. That the counter controls are in the correct positions for the measurement being made.

*The three conditions above should be verified before beginning any troubleshooting.*

D. That the Reset pulses (J301-J PNP Reset and J301-H NPN Reset) are present and correct.

E. That the STORAGE ON-OFF, DISPLAY and attenuator controls are working properly.

F. That all decades past the Input Amp. and Decade are working properly.

*These assumptions should be checked if the logic Troubleshooting procedure fails to locate the problem.*

The signal waveforms which appear in Figure 4-17 are keyed for use with the troubleshooting charts. These waveforms are representative of the signals found in the instrument circuitry and do not necessarily provide an accurate reference for all operating conditions.

The recommended test equipment for troubleshooting is provided in Table 4-1 (following page).

TABLE 4-1

RECOMMENDED TEST EQUIPMENT FOR TROUBLESHOOTING

| DESIGNATION | NAME |
|---|---|
| Simpson | Volt-ohm-milliameter, 3% accuracy |
| Tektronix Model 581 with type 82 plug-in | Oscilloscope; 100 mV sensitivity to 50 MHz |
| Hewlett Packard 308D | Signal Generator; 10 kHz - 100 MHz, 0.1V to 0.5V output, 50-Ω load |
| Systron-Donner 11334 | 15-pin PC Board Extender |
| Systron-Donner 11331 | 22-pin PC Board Extender |
| Systron-Donner 11333 | 10-pin PC Board Extender |
| Hewlett Packard 202A | LF Signal Generator 0-1000 Hz, 0.1 to 3.0 volts output, 50Ω load |
| Systron-Donner 1926A Plug-in | Time Interval Measurement Plug-in (Required to test Time B/A, Ratio C/A, and Ratio C/B-A functions) |

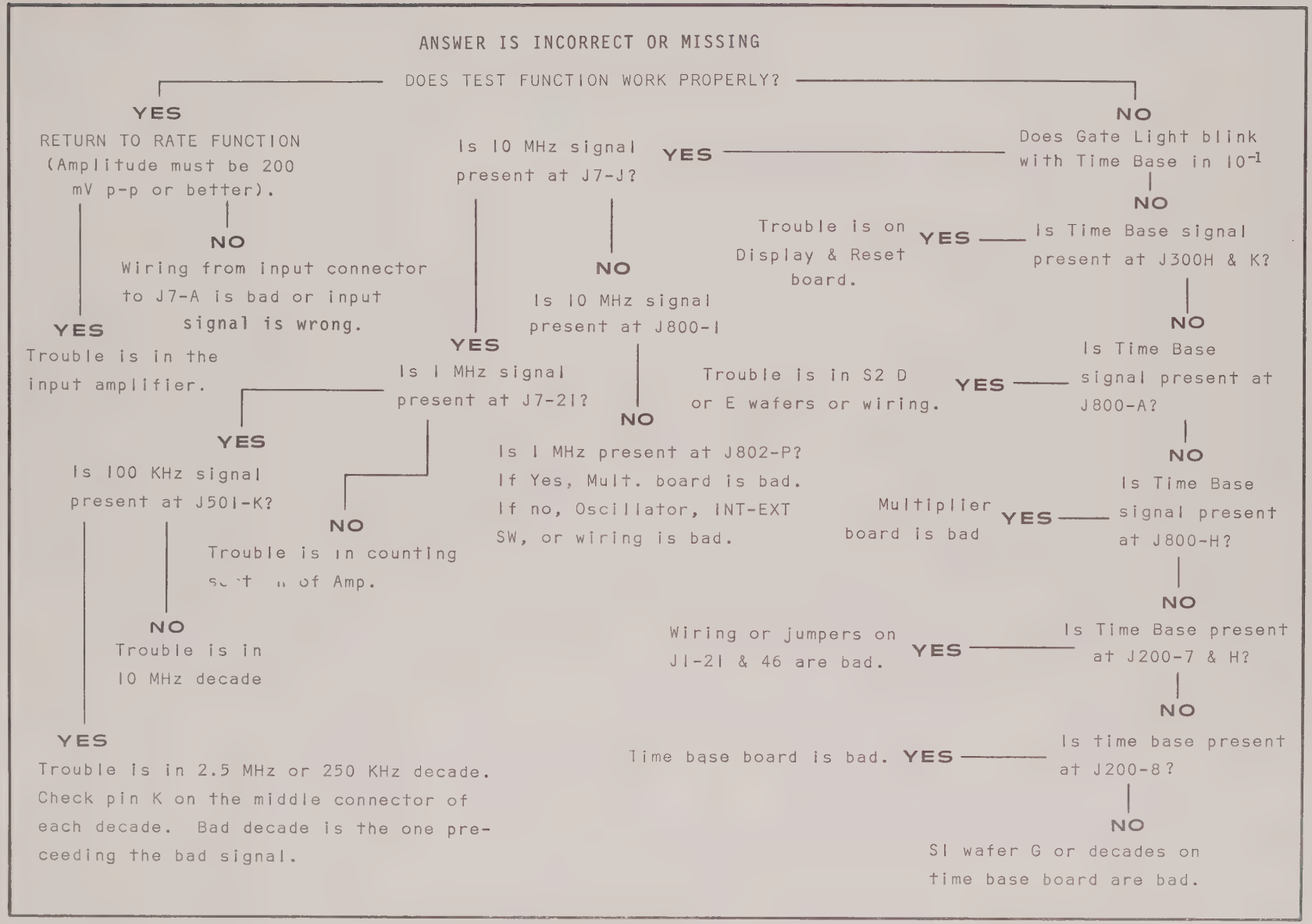

ANSWER IS INCORRECT OR MISSING
DOES TEST FUNCTION WORK PROPERLY?
YES
RETURN TO RATE FUNCTION (Amplitude must be 200 mV p-p or better).
NO
Wiring from input connector to J7-A is bad or input signal is wrong.
YES
Trouble is in the input amplifier.
Is 10 MHz signal present at J7-J?
YES
NO
Is 10 MHz signal present at J800-1
YES
Is 1 MHz signal present at J7-21?
NO
Is 1 MHz present at J802-P? If Yes, Mult. board is bad. If no, Oscillator, INT-EXT SW, or wiring is bad.
YES
Is 100 KHz signal present at J501-K?
NO
Trouble is in counting section of Amp.
NO
Trouble is in 10 MHz decade
YES
Trouble is in 2.5 MHz or 250 KHz decade. Check pin K on the middle connector of each decade. Bad decade is the one preceeding the bad signal.
NO
Does Gate Light blink with Time Base in $10^{-1}$
YES
Trouble is on Display & Reset board.
NO
Is Time Base signal present at J300H & K?
YES
Trouble is in S2 D or E wafers or wiring.
NO
Is Time Base signal present at J800-A?
YES
Multiplier board is bad
NO
Is Time Base signal present at J800-H?
YES
Wiring or jumpers on J1-21 & 46 are bad.
NO
Is Time Base present at J200-7 & H?
YES
Time base board is bad.
NO
Is time base present at J200-8?
NO
S1 wafer G or decades on time base board are bad.

**FIGURE 4-8** Rate Function Troubleshooting Logic (Follow right side of tree for Test Function)

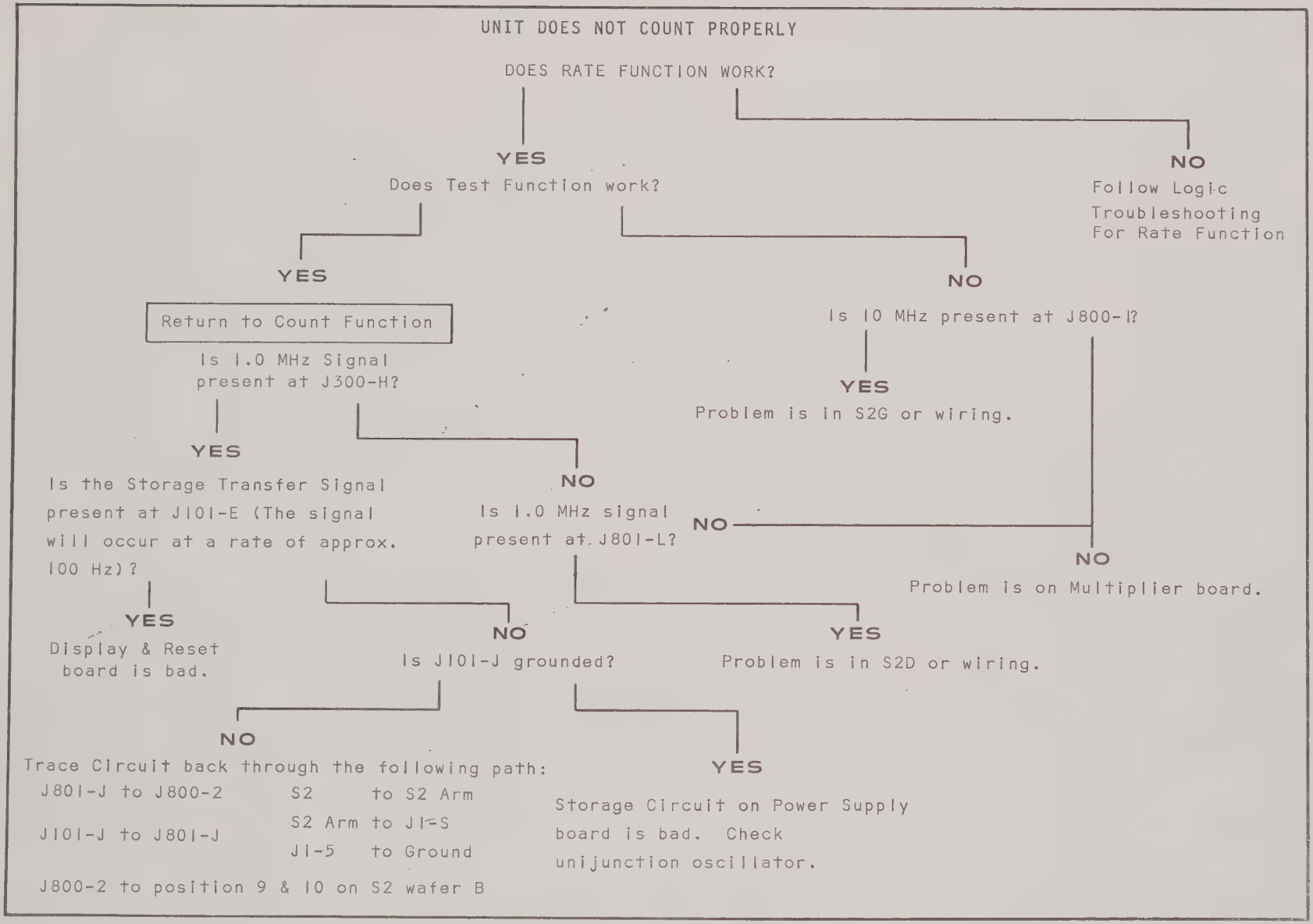

UNIT DOES NOT COUNT PROPERLY
DOES RATE FUNCTION WORK?
YES
Does Test Function work?
NO
Follow Logic Troubleshooting For Rate Function
YES
Return to Count Function
Is 1.0 MHz Signal present at J300-H?
NO
Is 10 MHz present at J800-1?
YES
Problem is in S2G or wiring.
YES
Is the Storage Transfer Signal present at J101-E (The signal will occur at a rate of approx. 100 Hz)?
NO
Is 1.0 MHz signal present at J801-L?
NO
NO
Problem is on Multiplier board.
YES
Display & Reset board is bad.
NO
Is J101-J grounded?
YES
Problem is in S2D or wiring.
NO
Trace Circuit back through the following path:
J801-J to J800-2
S2 to S2 Arm
J101-J to J801-J
S2 Arm to J1-5
J1-5 to Ground
J800-2 to position 9 & 10 on S2 wafer B
YES
Storage Circuit on Power Supply board is bad. Check unijunction oscillator.

**FIGURE 4-9** Count Function, Troubleshooting Logic

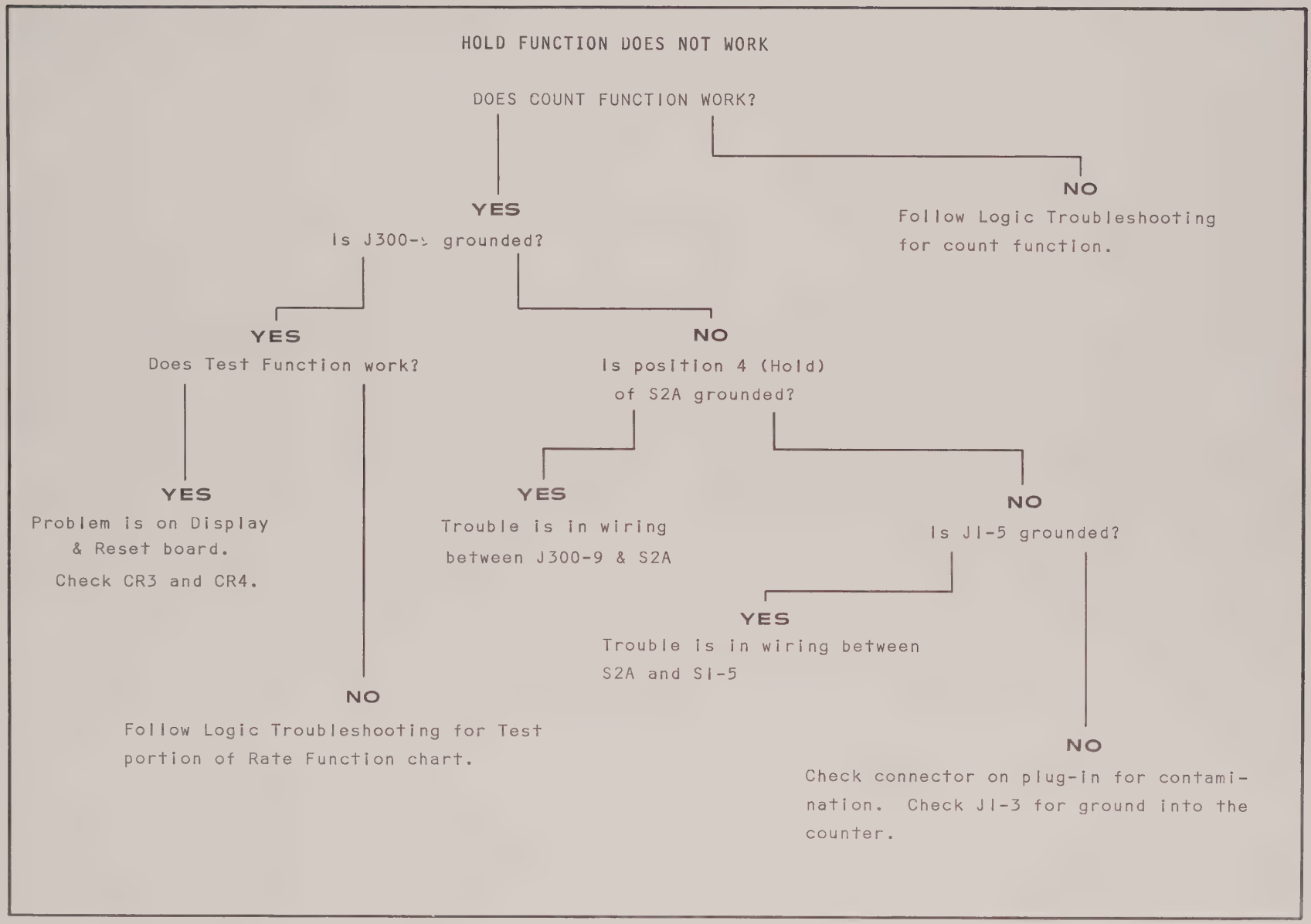

HOLD FUNCTION DOES NOT WORK
DOES COUNT FUNCTION WORK?
NO
Follow Logic Troubleshooting for count function.
YES
Is J300-9 grounded?
YES
Does Test Function work?
YES
Problem is on Display & Reset board.
Check CR3 and CR4.
NO
Follow Logic Troubleshooting for Test portion of Rate Function chart.
NO
Is position 4 (Hold) of S2A grounded?
YES
Trouble is in wiring between J300-9 & S2A
NO
Is J1-5 grounded?
YES
Trouble is in wiring between S2A and S1-5
NO
Check connector on plug-in for contamination. Check J1-3 for ground into the counter.

**FIGURE 4-10** Hold Function, Troubleshooting Logic

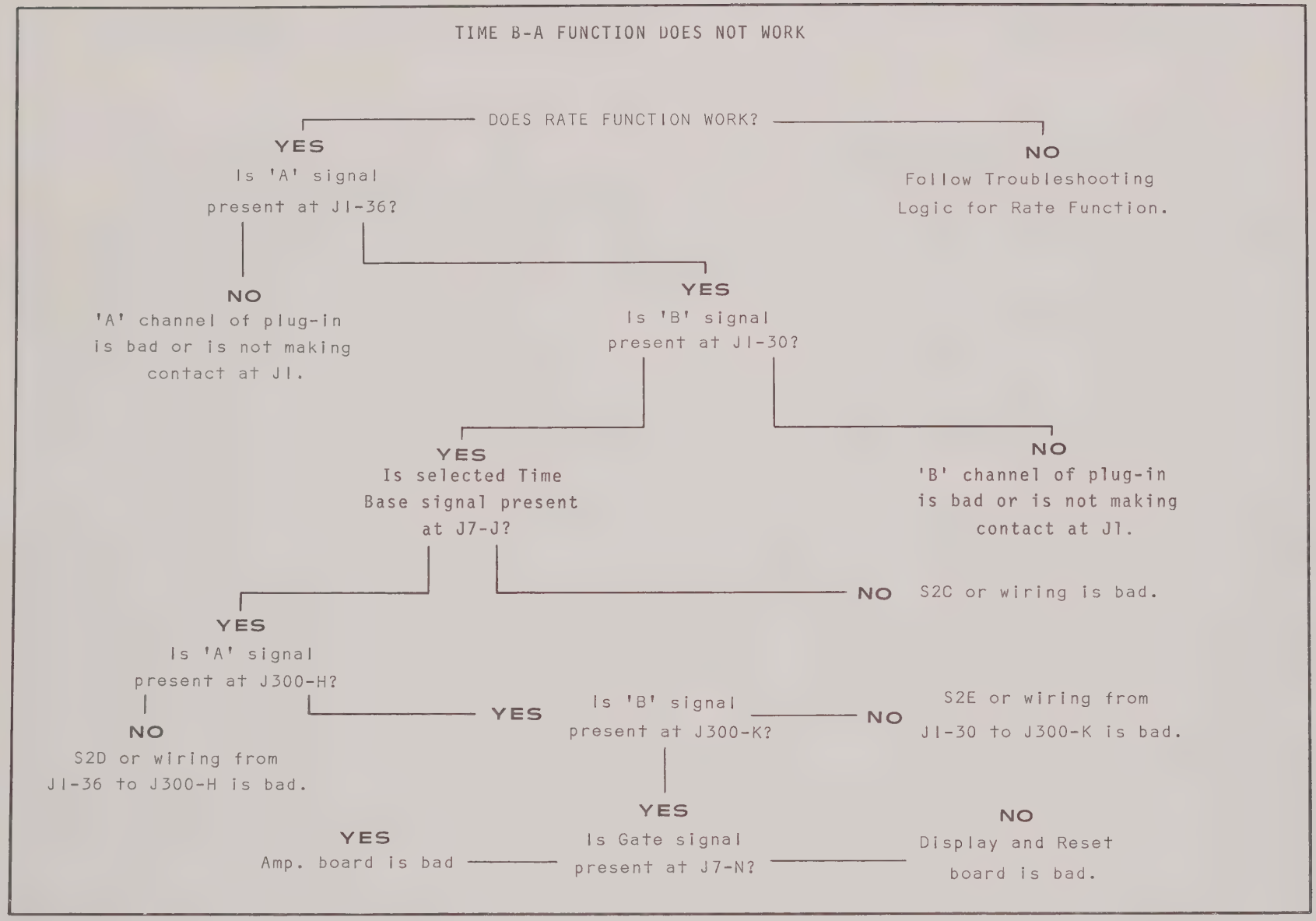

TIME B-A FUNCTION DOES NOT WORK
DOES RATE FUNCTION WORK?
YES
Is 'A' signal present at J1-36?
NO
Follow Troubleshooting Logic for Rate Function.
NO
'A' channel of plug-in is bad or is not making contact at J1.
YES
Is 'B' signal present at J1-30?
YES
Is selected Time Base signal present at J7-J?
NO
'B' channel of plug-in is bad or is not making contact at J1.
NO
S2C or wiring is bad.
YES
Is 'A' signal present at J300-H?
NO
S2D or wiring from J1-36 to J300-H is bad.
YES
Is 'B' signal present at J300-K?
NO
S2E or wiring from J1-30 to J300-K is bad.
YES
Is Gate signal present at J7-N?
YES
Amp. board is bad
NO
Display and Reset board is bad.

**FIGURE 4-11** Time B-A Function, Troubleshooting Logic

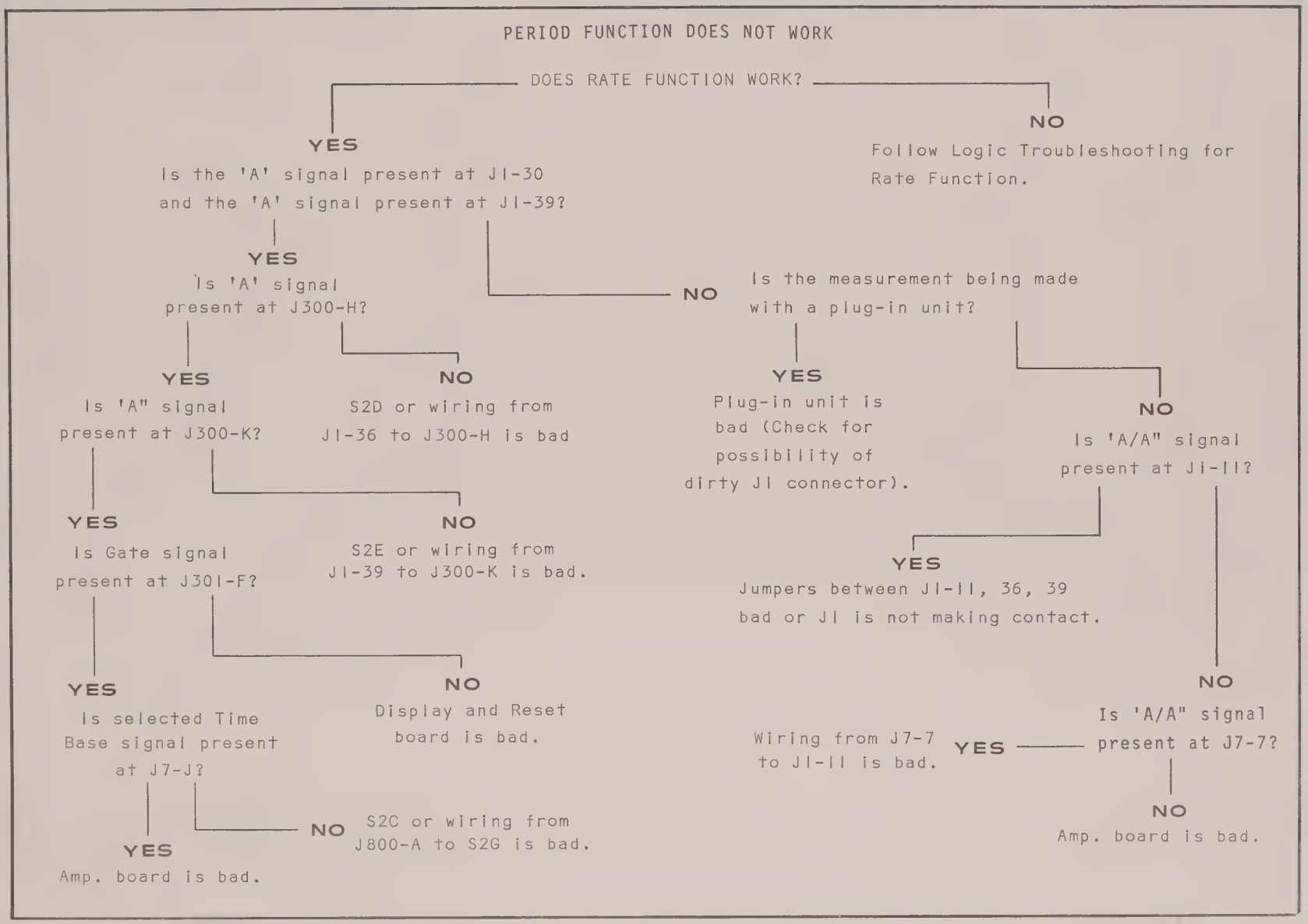

PERIOD FUNCTION DOES NOT WORK
DOES RATE FUNCTION WORK?
NO
Follow Logic Troubleshooting for Rate Function.
YES
Is the 'A' signal present at J1-30 and the 'A' signal present at J1-39?
NO
Is the measurement being made with a plug-in unit?
YES
Plug-in unit is bad (Check for possibility of dirty J1 connector).
NO
Is 'A/A" signal present at J1-11?
YES
Jumpers between J1-11, 36, 39 bad or J1 is not making contact.
NO
Is 'A/A" signal present at J7-7?
YES
Wiring from J7-7 to J1-11 is bad.
NO
Amp. board is bad.
YES
Is 'A' signal present at J300-H?
NO
S2D or wiring from J1-36 to J300-H is bad
YES
Is 'A" signal present at J300-K?
NO
S2E or wiring from J1-39 to J300-K is bad.
YES
Is Gate signal present at J301-F?
NO
Display and Reset board is bad.
YES
Is selected Time Base signal present at J7-J?
NO
S2C or wiring from J800-A to S2G is bad.
YES
Amp. board is bad.

**FIGURE 4-12** Period Function, Troubleshooting Logic

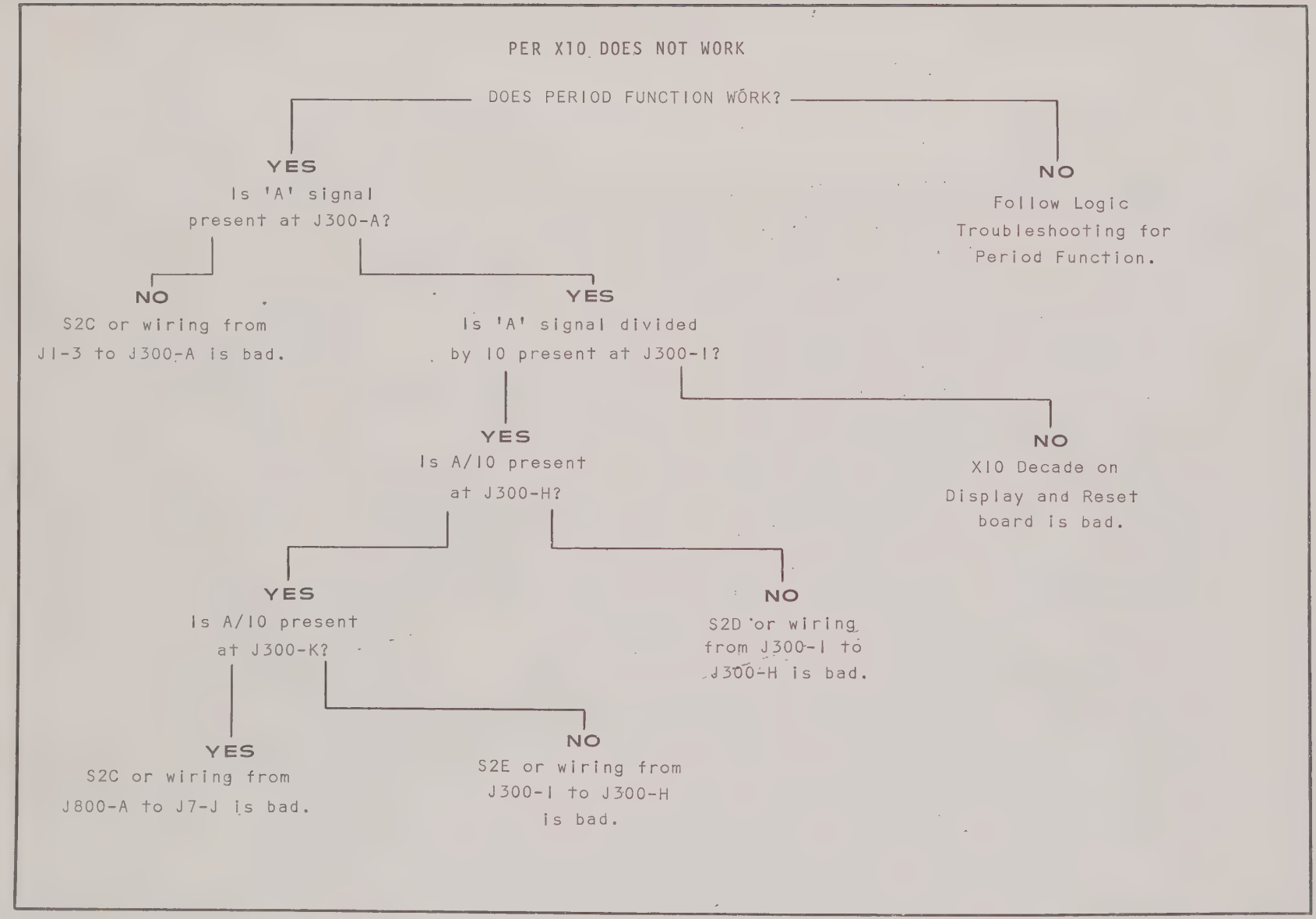

PER X10 DOES NOT WORK
DOES PERIOD FUNCTION WORK?
YES
Is 'A' signal present at J300-A?
NO
Follow Logic Troubleshooting for Period Function.
NO
S2C or wiring from J1-3 to J300-A is bad.
YES
Is 'A' signal divided by 10 present at J300-1?
YES
Is A/10 present at J300-H?
NO
X10 Decade on Display and Reset board is bad.
YES
Is A/10 present at J300-K?
NO
S2D or wiring from J300-1 to J300-H is bad.
YES
S2C or wiring from J800-A to J7-J is bad.
NO
S2E or wiring from J300-1 to J300-H is bad.

**FIGURE 4-13** Per X10, Troubleshooting Logic

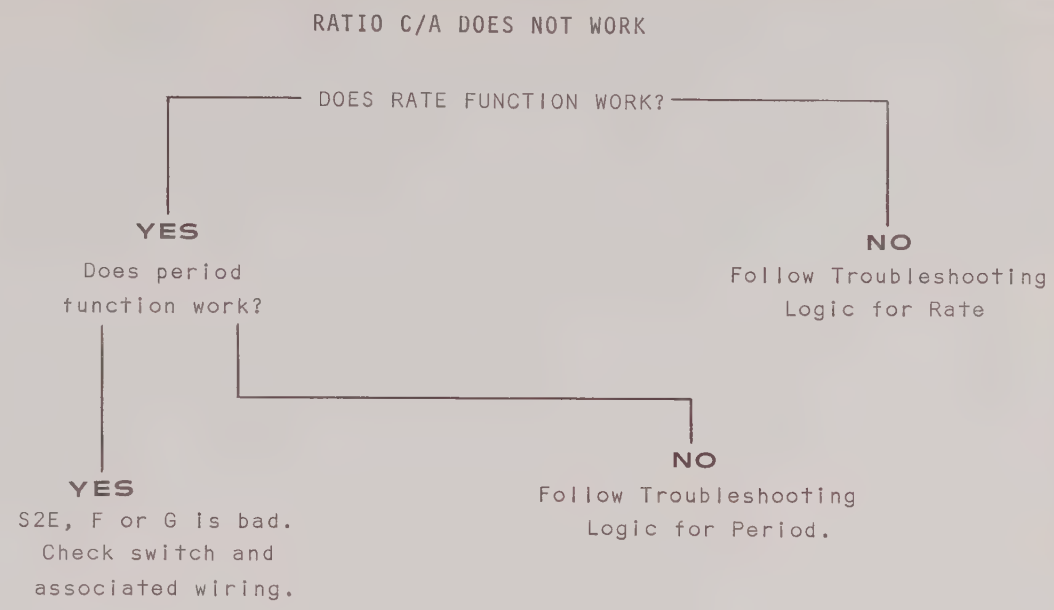



**FIGURE 4-14** Ratio C/A, Troubleshooting Logic

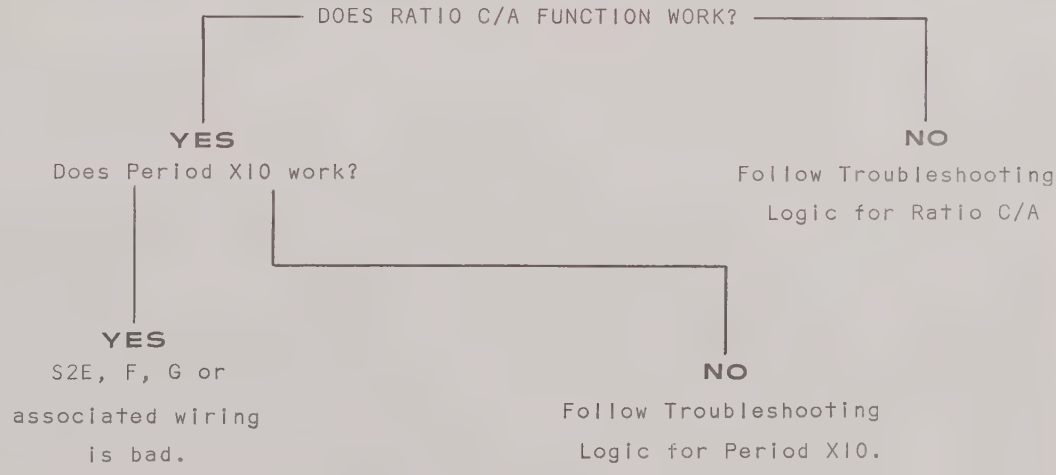



**FIGURE 4-15** Ratio C/A X10, Troubleshooting Logic

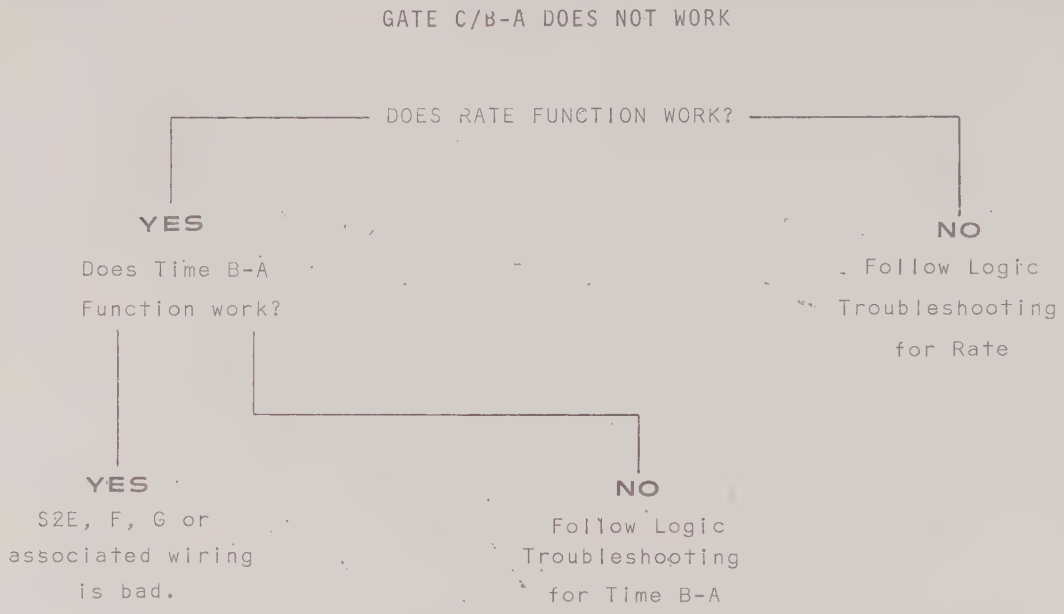
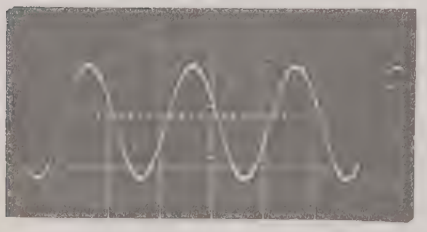


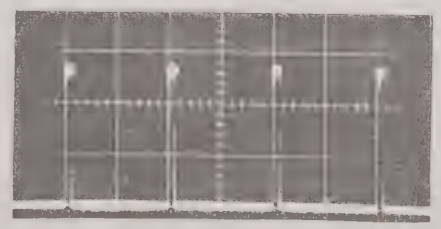

**FIGURE 4-16** Gate C/B-A, Troubleshooting Logic

4-17A Input Signal at top of R104




Vertical: 100 mV/cm (AC coupled)
Horizontal: .01μs/cm
Input: 300 mV rms at 50 MHz

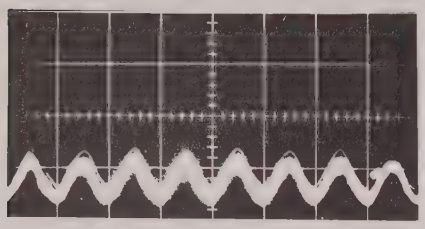
4-17B Time Base Signal at J300-H & A




Vertical: 2V/cm
Horizontal: 5μs/cm
Input: $10^{-5}$ T.B.

**FIGURE 4-17** Signal Waveforms

4-17C 10 MHz Signal at J800-1

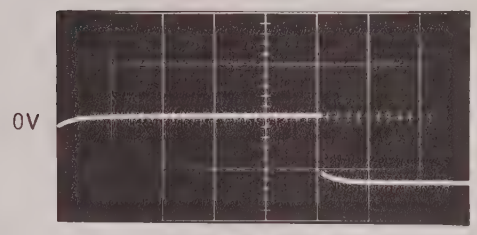



Vertical: 5 V/cm

Horizontal: .1μs/cm

Input: 10MHz Multiplier Output

4-17D Control Gate Signal at J7-N

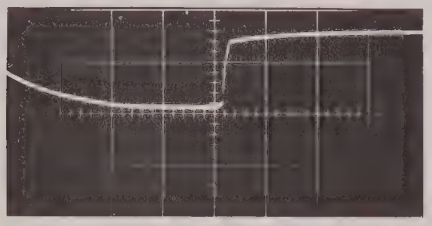



Vertical: 5V/cm

Horizontal: .2ms/cm

Input: $10^{-3}$ T.B.

4-17E Storage Transfer Signal at J101-E



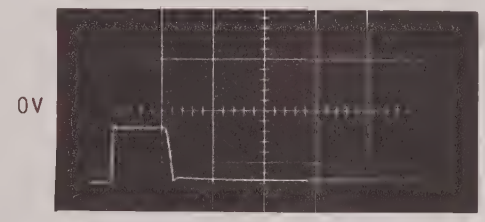

Vertical: 20V/cm

Horizontal: 50μs/cm

Input: $10^{-1}$ T.B.

Note: The $10^{-1}$ T.B. (10Hz) is patched from the T.B. Out Jack to the Input.

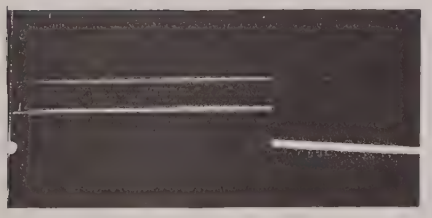
4-17F "A" Channel Input Signal at J1-3G




Vertical: 5 V/cm

Horizontal: 0.5μs/cm

Input: 1 kHz to "A" Input T.B. of 1926A Plug-in




4-17G Gated Input Signal at Q117 Base

Vertical: 2V/cm

Horizontal: 20μs/cm

Input: 50MHz C Input and $10^{-4}$ T.B.

**FIGURE 4-17** (continued) Signal Waveforms

# TABLE 4-2 BLOCK DIAGRAM TABULATION

| OPTION | | ADDITIONAL OPTION INFO. | 50 MHz AMP & DECADE | POWER SUPPLY | MULT. | ÷3 MULT. | TIME BASE | DISPLAY & RESET | 50 MHz READOUT | 10 MHz DECADE | 2.5 MHz DECADE | 250 kHz DECADE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STANDARD | SCHEMATIC | ~ | 13531 | 25344<br>23478 | 17970 | ~ | 15423 | 19244 | 12978 | 15201 | 11528 | 11524 |
| | ASSEMBLY | ~ | 13534 | 19681 | 17966 | ~ | 15422 | 19243 | 12979 | 15200 | 11527 | 11523 |
| B OPTION | SCHEMATIC | 15470 | | | ~ | 17597 | | | | | | |
| | ASSEMBLY | 15948 | | | ~ | 17596 | | | | | | |
| B3 OPTION | SCHEMATIC | 15847 | | | ~ | | | | | | | |
| | ASSEMBLY | 17058 | | | ~ | | | | | | | |
| B4 OPTION | SCHEMATIC | 27096 | | | ~ | | | | | | | |
| | ASSEMBLY | 27469 | | | ~ | | | | | | | |
| D1 OPTION | SCHEMATIC | 15678 | | | 17970 | ~ | | | 12978 | | | |
| | ASSEMBLY | 17030 | | | 17966 | ~ | | | 15577 | | | |
| D2 OPTION | SCHEMATIC | 17021 | | | | ~ | | | 12978 | | | |
| | ASSEMBLY | 17026 | | | | ~ | | | 12979 | | | |
| F OPTION | SCHEMATIC | S23027 | | | | ~ | | | | | | |
| | ASSEMBLY | S23028 | | | | ~ | | | | | | |

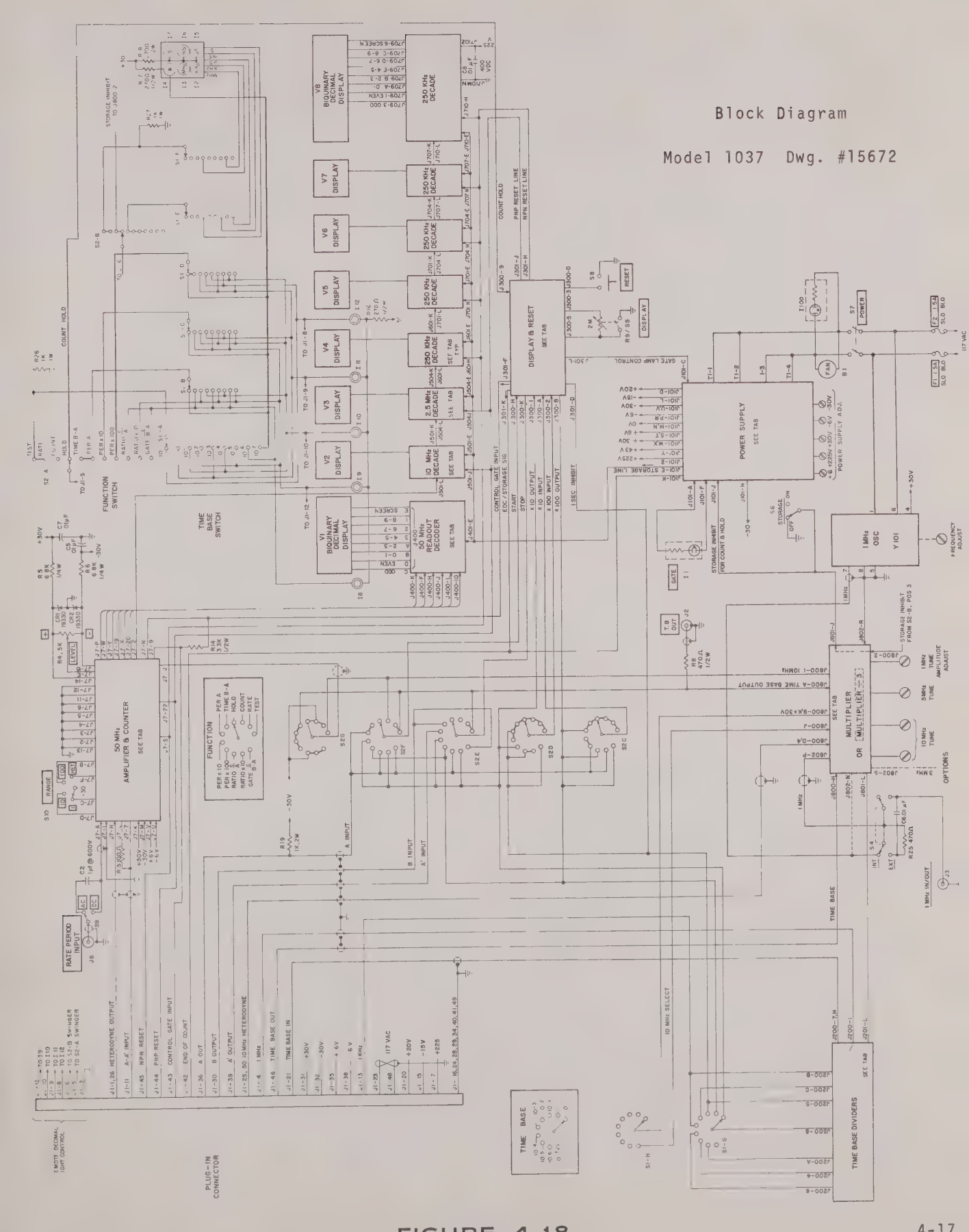

Block Diagram
Model 1037 Dwg. #15672
FUNCTION SWITCH
TIME BASE SWITCH
50 MHz AMPLIFIER & COUNTER
SEE TAB
DISPLAY & RESET
SEE TAB
POWER SUPPLY
SEE TAB
MULTIPLIER OR MULTIPLIER ÷ 3
SEE TAB
TIME BASE DIVIDERS
SEE TAB
READOUT DECODER
SEE TAB
1 MHz OSC Y 101
V8 BIQUINARY DECIMAL DISPLAY
V7 DISPLAY
V6 DISPLAY
V5 DISPLAY
V4 DISPLAY
V3 DISPLAY
V2 DISPLAY
V1 BIQUINARY DECIMAL DISPLAY
250 KHz DECADE
2.5 MHz DECADE
10 MHz DECADE
TIME BASE
PLUG-IN CONNECTOR
REMOTE DECIMAL LIGHT CONTROL
RATE PERIOD INPUT
FREQUENCY ADJUST
1 MHz IN/OUT
OPTIONS
117 VAC

FIGURE 4-18

## 4.3 50 MHz AMPLIFIER AND DECADE ASSEMBLY (Assembly 13534, Schematic 13531)

### A. General Description

Refer to the detailed block diagram, Figure 4-19. This section amplifies the input frequency applied to INPUT connector of the instrument. The amplified input frequency is then shaped and applied to a high-frequency decade divider circuit. A gating circuit between the amplifier and decade portions of the section controls the length of time that the input frequency is counted.

All components are mounted on a single plug-in printed-circuit board, Assembly 13534. Refer to Drawing 13531 for the schematic diagram of this section. This assembly is common to both the standard SD 1017 Frequency Meter and SD 1037 Counter-Timer.

The major functional circuits are: 1) input attenuator; 2) input amplifier; and 3) counter.

### B. Input Attenuator (Schematic 13531, Sheet 1 of 2)

The RANGE switch energizes the relays K101 through K104 which select either the HET or INPUT signal line and provides for selection of one of three attenuation ratios (1, 10, 100) in the INPUT signal line. C101, C102, and C103 provide frequency compensation for the three attenuation ranges and are adjusted for the best 10 kHz square wave response at the base of Q101.

### C. Input Amplifier (Schematic 13531, Sheet 1 of 2)

The INPUT or HET signal is summed with a variable DC bias (trigger LEVEL control) at the base of Q101. Q101, 102, and 103 form a three-stage direct-coupled feedback amplifier with an overall gain of about 10. The input at the base of Q101 is limited at -6 V by CR101 and at +6 V by the saturation of this transistor. Diodes CR102 and CR103 in the emitter circuit of Q102 provide temperature compensation of the stage. Q104 and 105 form a Schmitt trigger circuit which produces a rectangular output when the input signal passes through a hysteresis of about 0.8 V (equivalent to about 0.1 V at the INPUT connector). The output of the Schmitt trigger is fed through a emitter-follower stage Q106 to the "function" gate, Q107. This gate and the FUNCTION switch (S2) determine which signal is to be counted and which signal (in the 1037 models) is to be used to control the counting interval. In the RATE mode, the gate is activated and the INPUT signal is counted; in the TEST position the gate is disabled and the internally generated 10 MHz signal is routed through Q108 to the ring-divider. When a time interval mode is selected (1037 only) the gate is disabled, the selected counter time base output is routed through Q108 to be counted while the INPUT signal (or a signal derived from a compatible plug-in) is fed through Q109 to the counter gate control circuits.

### D. Counter (Schematic 13531, sheet 2 of 2)

The output of Q107 is fed to one input of the "counting-interval" gate Q117. This gate is activated by the counter gate signal for a precise time interval. The origin of this signal and its duration is determined by the setting of the TIME BASE and FUNCTION switches as described above. The output from Q117 is fed to a fast-response signal shaping circuit consisting of Q118, 119, 120, 134 and tunnel diodes CR111 and CR112.

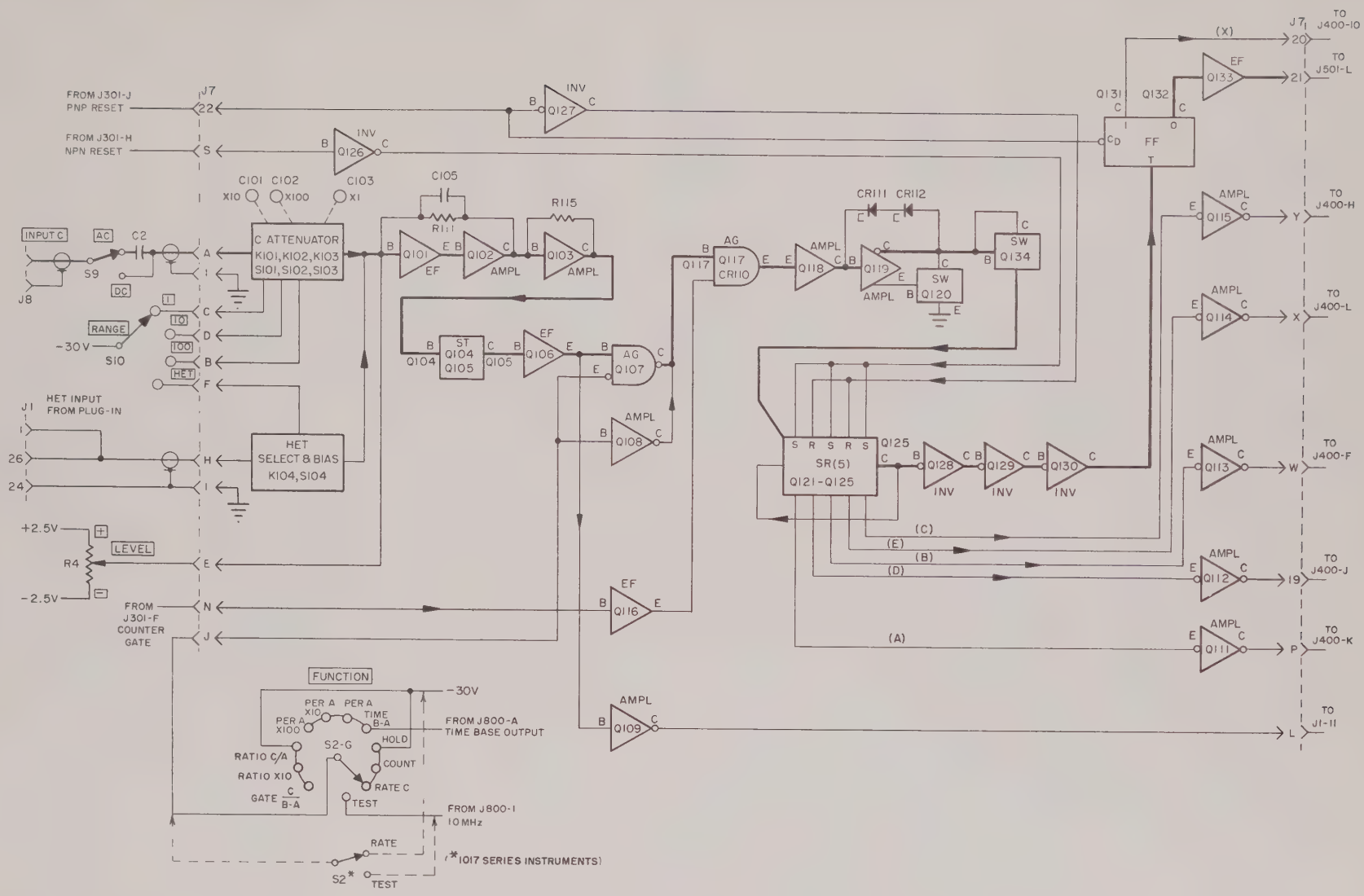
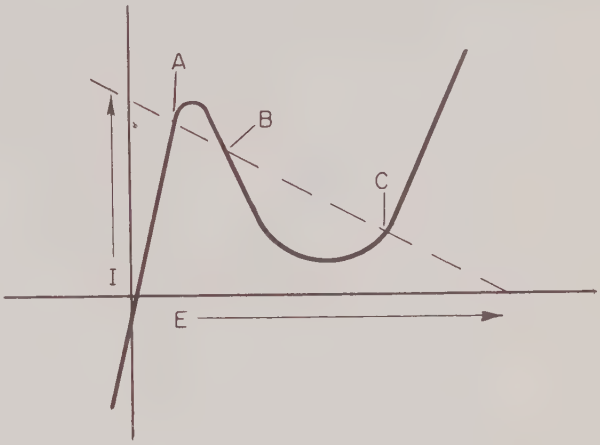



**FIGURE 4-19** Detailed Block Diagram - 50 MHz Amplifier and Counter

On the negative half-cycle of the signal at the emitter of Q117, Q118 conducts; Q119 and Q120 are off. The tunnel diodes are in their high level condition (point C in Figure 4-20), about 0.5 volts. The voltage at the emitter of diode-connected Q134 is then the sum of the voltage drops across the two tunnel diodes (1.0 V) and the voltage drop across Q118 (0.7 V) less the voltage drop across Q134 (0.7 V), about +1.0 V. On the positive half-cycle, Q118 cuts off driving Q119 into conduction. The tunnel diodes quickly switch to their low state (point A in Figure 4-20) driving Q119 further into conduction and switching Q120 on. The voltage at the emitter of Q134 is now the sum of the voltage drops across Q134 and Q120, about +1.5 V. The +1.0 and +1.5 V logic levels thus established provide the proper triggering level for the ring counter.

The ring counter is a five-stage shift-register with the serial output connected back to the serial input to give ring operation. Each stage consists of a transistor/tunnel diode bistable latch operating at logic levels of +0.7 and 1.2 V, the difference being equal to the tunnel diode swing from its "ON" to its "OFF" state.




The load line intersecting points A, B, and C is typical of the switching characteristic. Points A and C are the two stable operating points of the diode, and point B represents the negative resistance region characteristic. The tunnel diode is highly conductive for all reverse biases.

**FIGURE 4-20**

Typical Tunnel Diode Switching Characteristics

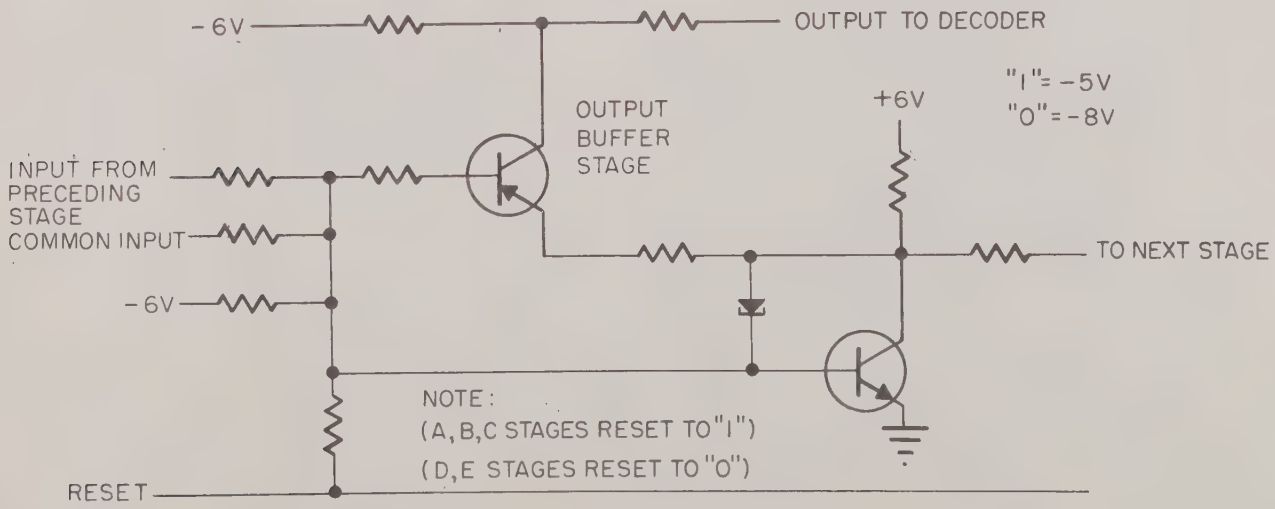



**FIGURE 4-21** Ring Counter Stage

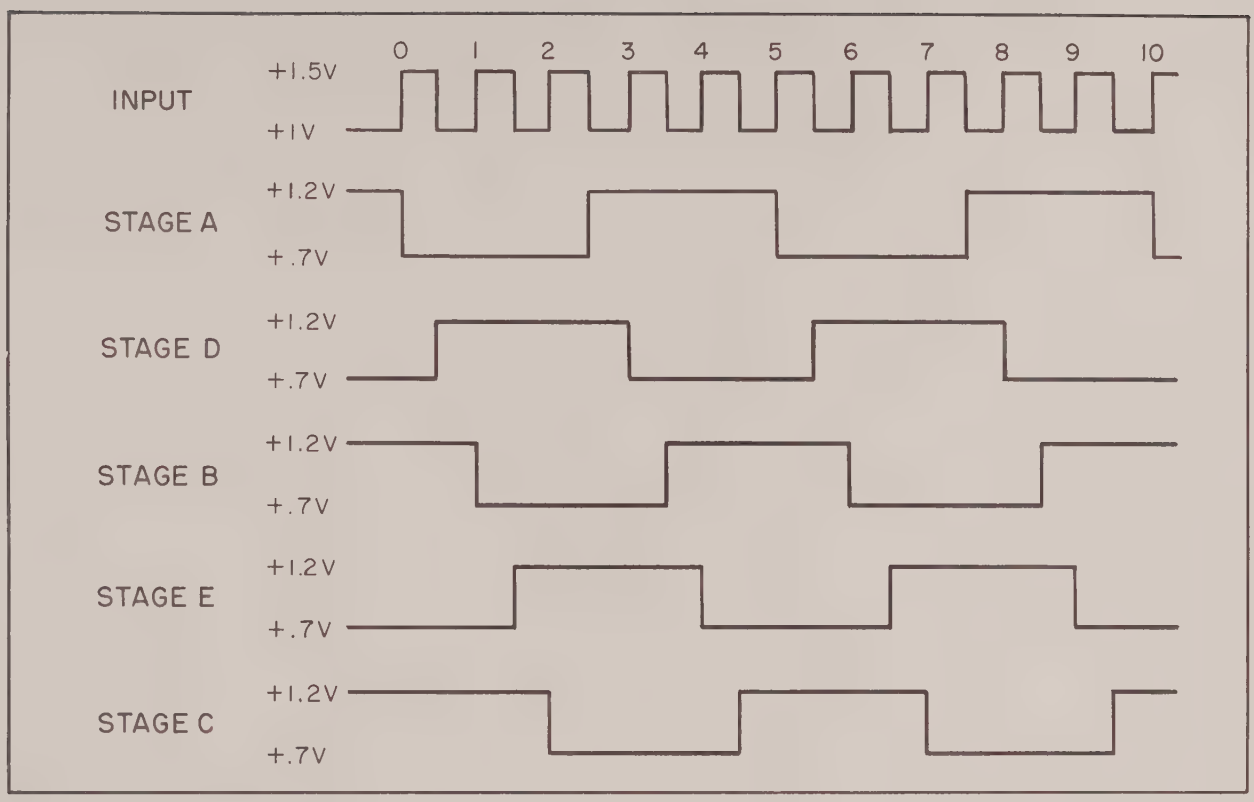



**FIGURE 4-22** Collector Switching Waveforms

TABLE 4-2
Ring Counter Parallel Output

| SHIFT INPUT | STAGE |
|---|---|
| | A D B E C |
| 0 | 1 0 1 0 1 |
| 1 | 0 1 1 0 1 |
| 2 | 0 1 0 1 1 |
| 3 | 1 1 0 1 0 |
| 4 | 1 0 1 1 0 |
| 5 | 1 0 1 0 1 |
| 6 | 0 1 1 0 1 |
| 7 | 0 1 0 1 1 |
| 8 | 1 1 0 1 0 |
| 9 | 1 0 1 1 0 |
| 0 | 1 0 1 0 1 |

At the end of each counting interval, the PNP and NPN reset lines preset the counter such that the "shift" input (signal pulses) provides the switching waveforms shown in Figure 4-22 and the logic of Table 4-2. Note that the parallel output lines are in "quinary" form, i.e. a parallel 5-bit code representing the decimal count 0-5; 1-6; 2-7; 3-8; and 4-9. The serial output (collector of Q125) is at 1/5 of the shift input. This output triggers the ÷2 flip-flop, Q131 and 132, after inversion and a level change through inverters Q128, 129, and 130. One side of this flip-flop (at 1/10 the INPUT frequency) is used to trigger the 10 MHz Decade; the other provides the "0,1,2,3,4 or 5,6,7,8,9" information necessary to complete the "qui-binary" coded signal count. This "qui-binary" coded count is fed to the 50 MHz Readout for conversion to "bi-quinary" form and display as the least significant digit of the total count.

## E. Troubleshooting

When a failure is experienced, and the cause is localized to the 50 MHz Amplifier and Decade board assembly (by use of the troubleshooting logic figures in Paragraph 4-2) use the following procedure to locate the defective circuit.

With the counter turned off, remove the 50 MHz Amplifier and Decade board from connector J7 and replace with 22 pin extender board (Assembly #11331). Insert 50 MHz board into extender and turn counter on.

*NOTE*

*Do not re-insert 50 MHz board into the counter if the failure has resulted in one or more fuses being blown or smoke rising from the counter. Visually inspect the board and use an ohmmeter to locate the failure.*

*Isolate the failure using Paragraph 4.3 F and the Troubleshooting Chart in 4-23 A or, if the trouble is traced to the ring divider circuit, follow the procedure given in Paragraph 4.3 G.*

## F. Amplifier Troubleshooting

The first step in troubleshooting the 50 MHz board is to determine whether the trouble lies in the amplifier section or decade section. If the counter operates properly in any one function, it may be assumed that the trouble is in the amplifier section (amplifier, attenuator, trigger and function gate.) The decade section contains counting-interval gate, the ring divider, ÷2 flip-flop, reset drivers, and logic buffer circuitry. To determine which section has failed, connect the vertical input of an oscilloscope to the collector of Q7. The waveform at this point should show the shaped input signal. If the proper signal is observed, the trouble lies in the decade section. If the signal is absent, distorted or reduced in amplitude, the trouble is in the amplifier section. Refer to Figure 4-23 A for troubleshooting of the amplifier section or Figure 4-23 B for the decade section.

## G. Decade Troubleshooting

Failures in the ring are classed as either low frequency failures or high frequency failures.

The low frequency component is defined as the DC switching which occurs at one-fifth the frequency of the input signal. The low frequency failures are caused by the inability of one or more stages to properly switch (in response to a change in switching bias from the previous stage[s]) or hold the proper reset condition. Generally speaking, when this type of failure occurs, it causes improper operation over the entire frequency range of the ring and is independent of the input signal amplitude. The following procedure outlines the steps to be taken in troubleshooting this type of failure.

1) Place the FUNCTION switch in the COUNT position. (If the unit is a Model 1017 Frequency Meter, ground Pin J7-N instead, and place the FUNCTION Switch in the RATE position).

2) Rotate the level control to the extreme counter-clockwise position (-). Depress the RESET switch.

3) Referring to Figure 4-22, Collector Switching Waveforms, check the collector of each ring transistor for the proper

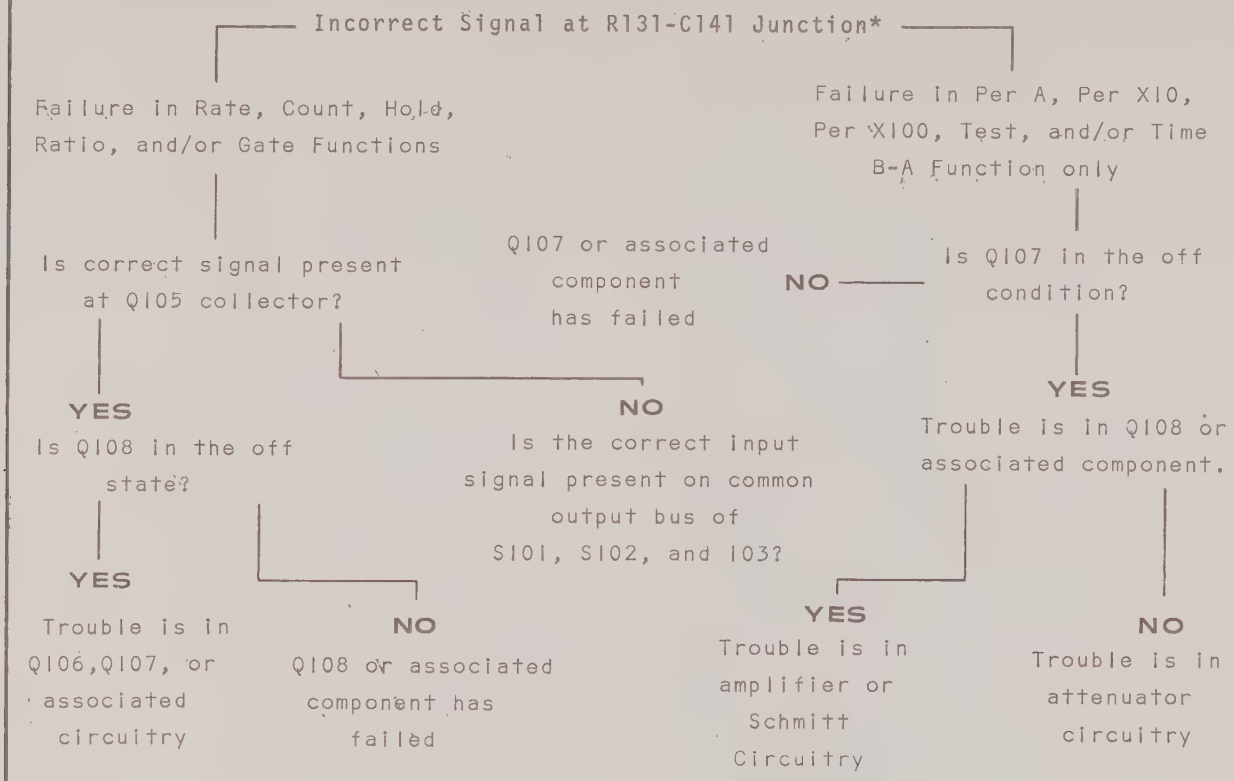
condition ("on" or "off" state as indicated for the reset condition) with an oscilloscope or voltmeter. If one or more conditions do not coincide with those in Figure 4-22, ensure that each stage is responding to the reset pulse applied to it (generated with the RESET switch). The reset pulse is sufficient to overcome an incorrect bias level from a previous stage.

4) If the conditions observed in Step 3 are correct, cycle the ring with the LEVEL Control. Rotating the control from the extreme counter-clockwise (-) position to the extreme clockwise (+) position will provide the equivalent of one-half cycle of input. Returning the control to the (-) position will provide another half-cycle of input, thus the one condition (Figure 4-22) is reached. Repeat this procedure for one complete cycle of ring operation (5 cycles of input), and observe each collector for the proper condition with each half-cycle of input. When an improper level is observed, the effect of the switching bias from the previous stage must be taken into account. Use of a voltmeter will localize the failure to one or two stages. Once the failure is localized, use of an ohmmeter will provide the most expedient means of finding the defective component.

A high frequency failure of the ring divider indicates that a component in the ring will not properly respond to the high frequency currents and voltages it must handle. This type of failure is difficult to find and generally requires the use of a high frequency oscilloscope (Tektronix 585 or equivalent) if it is to be located with normal troubleshooting procedures. The most frequent cause of high frequency failure is a transistor or tunnel diode which experiences a change in characteristic at the higher ring frequencies. The most convenient method for locating the defective stage is outlined in the following procedure.

1) Increase input frequency to the point where the counter begins to give erroneous readout indications (FUNCTION switch in RATE position).

2) Using a soldering iron, heat each ring transistor in turn. Place the iron near the case of the transistor for a few seconds. *DO NOT TOUCH THE TRANSISTOR CASE WITH THE SOLDERING IRON.* Heat the transistor just to the point where the case is hot to the touch. Allow enough time to see if the readout stabilizes at the correct reading before heating the next transistor.


Incorrect Signal at R131-C141 Junction*
Failure in Rate, Count, Hold, Ratio, and/or Gate Functions
Failure in Per A, Per X10, Per X100, Test, and/or Time B-A Function only
Is correct signal present at Q105 collector?
Q107 or associated component has failed
NO
Is Q107 in the off condition?
YES
Is Q108 in the off state?
NO
Is the correct input signal present on common output bus of S101, S102, and 103?
YES
Trouble is in Q108 or associated component.
YES
Trouble is in Q106, Q107, or associated circuitry
NO
Q108 or associated component has failed
YES
Trouble is in amplifier or Schmitt Circuitry
NO
Trouble is in attenuator circuitry

*NOTE: 1. If, in measuring the period of the C Input Signal when the counter operates properly in Rate, the Time Base Signal at the R131-C141 Junction is correct, the trouble will be found in the circuit of Q109.

2. If, in the Ratio or Gate Function, the Signal at the R131-C141 Junction is correct, the trouble will be found in the circuit of Q109.

3. Certain types of failures may affect operation only at high frequencies. If this occurs, provide an input at the maximum specified frequency for the failed function and watch for large reductions in amplitude or signal distortion (high frequency scope required). Minimum acceptable signal amplitude (at any given point) is greater than the minimum amplitude required for proper operation at 1 MHz.

**FIGURE 4-23A** AMPLIFIER TROUBLESHOOTING GUIDE

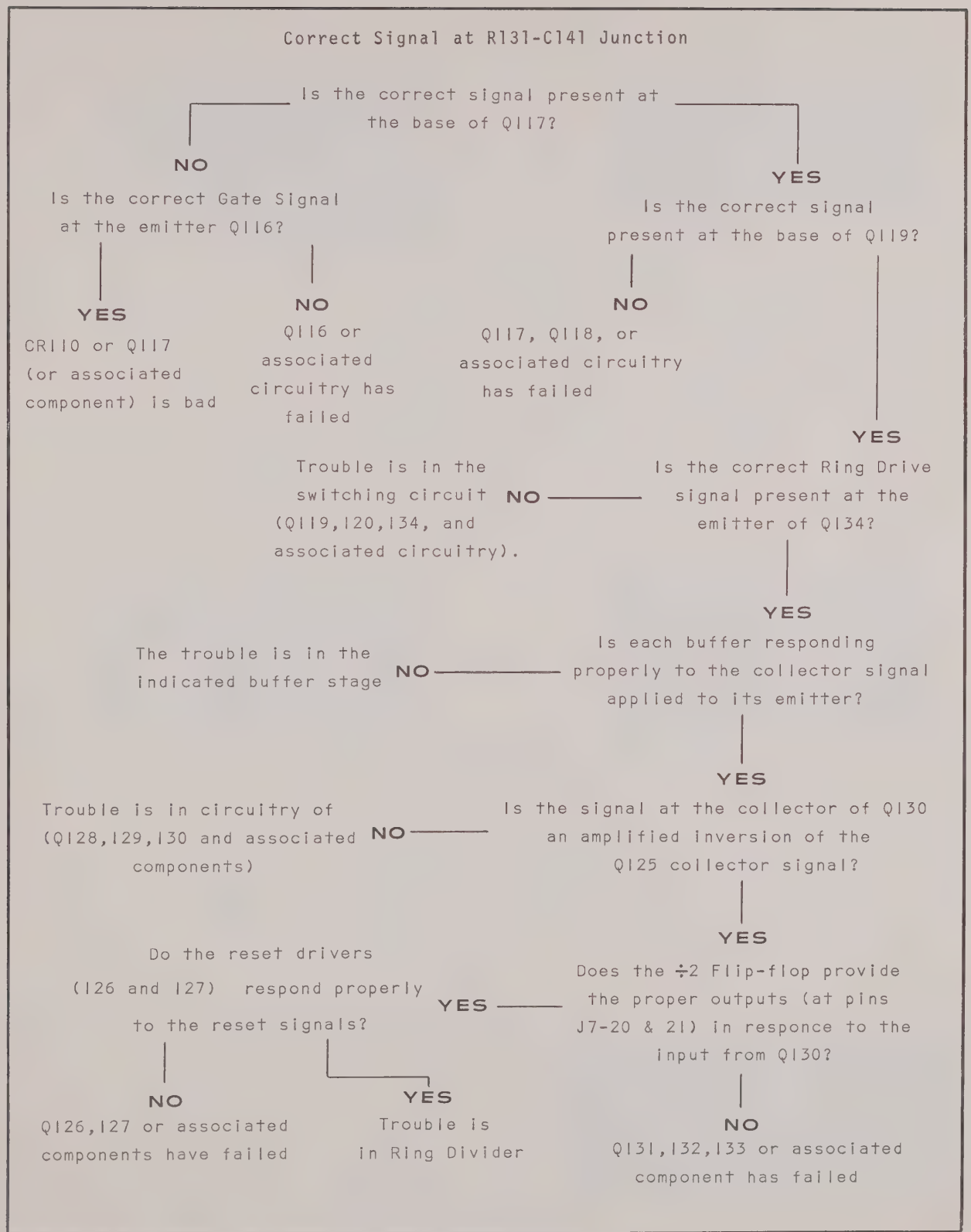
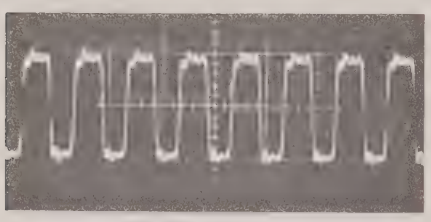

Correct Signal at R131-C141 Junction
Is the correct signal present at the base of Q117?
NO
Is the correct Gate Signal at the emitter Q116?
YES
CR110 or Q117 (or associated component) is bad
NO
Q116 or associated circuitry has failed
YES
Is the correct signal present at the base of Q119?
NO
Q117, Q118, or associated circuitry has failed
YES
Is the correct Ring Drive signal present at the emitter of Q134?
NO
Trouble is in the switching circuit (Q119,120,134, and associated circuitry).
YES
Is each buffer responding properly to the collector signal applied to its emitter?
NO
The trouble is in the indicated buffer stage
YES
Is the signal at the collector of Q130 an amplified inversion of the Q125 collector signal?
NO
Trouble is in circuitry of (Q128,129,130 and associated components)
YES
Does the ÷2 Flip-flop provide the proper outputs (at pins J7-20 & 21) in responce to the input from Q130?
NO
Q131,132,133 or associated component has failed
YES
Do the reset drivers (126 and 127) respond properly to the reset signals?
NO
Q126,127 or associated components have failed
YES
Trouble is in Ring Divider

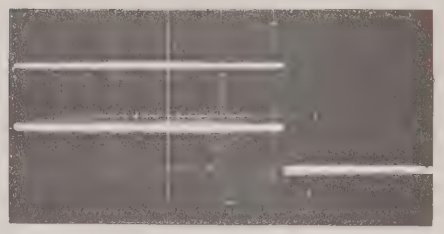
**FIGURE 4-23B** DECADE SECTION TROUBLESHOOTING GUIDE

4-24A Schmitt Output (Q105 Collector)



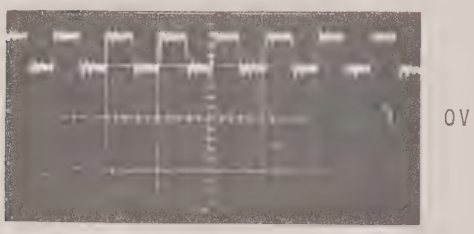
| | |
|---|---|
| Input: | 10MHz at 100mV |
| FUNCTION: | RATE |
| TIME BASE: | $10^{-3}$ sec |
| Vertical: | 1V/cm -- ac coupling |
| Horizontal: | 0.1μs/cm |

4-24B Gate Input Signal (Q117 Base)



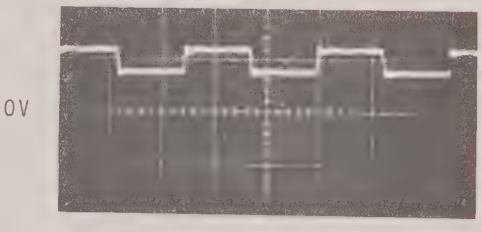

| | |
|---|---|
| Input: | 10MHz at 100mV |
| FUNCTION: | RATE |
| TIME BASE: | $10^{-3}$ sec |
| Vertical: | 2V/cm -- dc coupling |
| Horizontal: | 0.2ms/cm |

4-24C Ring Drive Signal (Q134 Emitter)

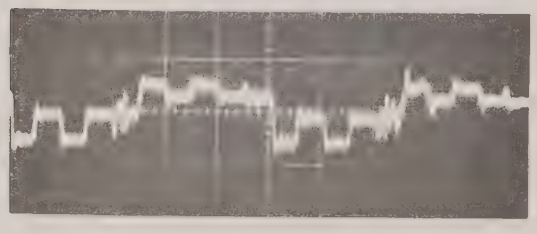



| | |
|---|---|
| Input: | 10MHz at 100mV |
| FUNCTION: | RATE |
| TIME BASE: | $10^{-3}$ sec |
| Vertical: | 1V/cm -- dc coupling |
| Horizontal: | 0.1μs/cm |

4-24D Ring Stage Collector Signal (Q121)




| | |
|---|---|
| Input: | 10MHz at 100mV |
| FUNCTION: | RATE |
| TIME BASE: | 10 sec |
| Vertical: | 1V/cm -- dc coupling |
| Horizontal: | 0.2μs/cm |



4-24E Ring Stage Base Signal (Q121)

| | |
|---|---|
| Input: | 10MHz at 100mV |
| FUNCTION: | RATE |
| TIME BASE: | 10 sec |
| Vertical: | 0.1V/cm -- ac coupling |
| Horizontal: | 0.1μs/cm |

**FIGURE 4-24** 50MHz Amplifier and Decade Waveforms

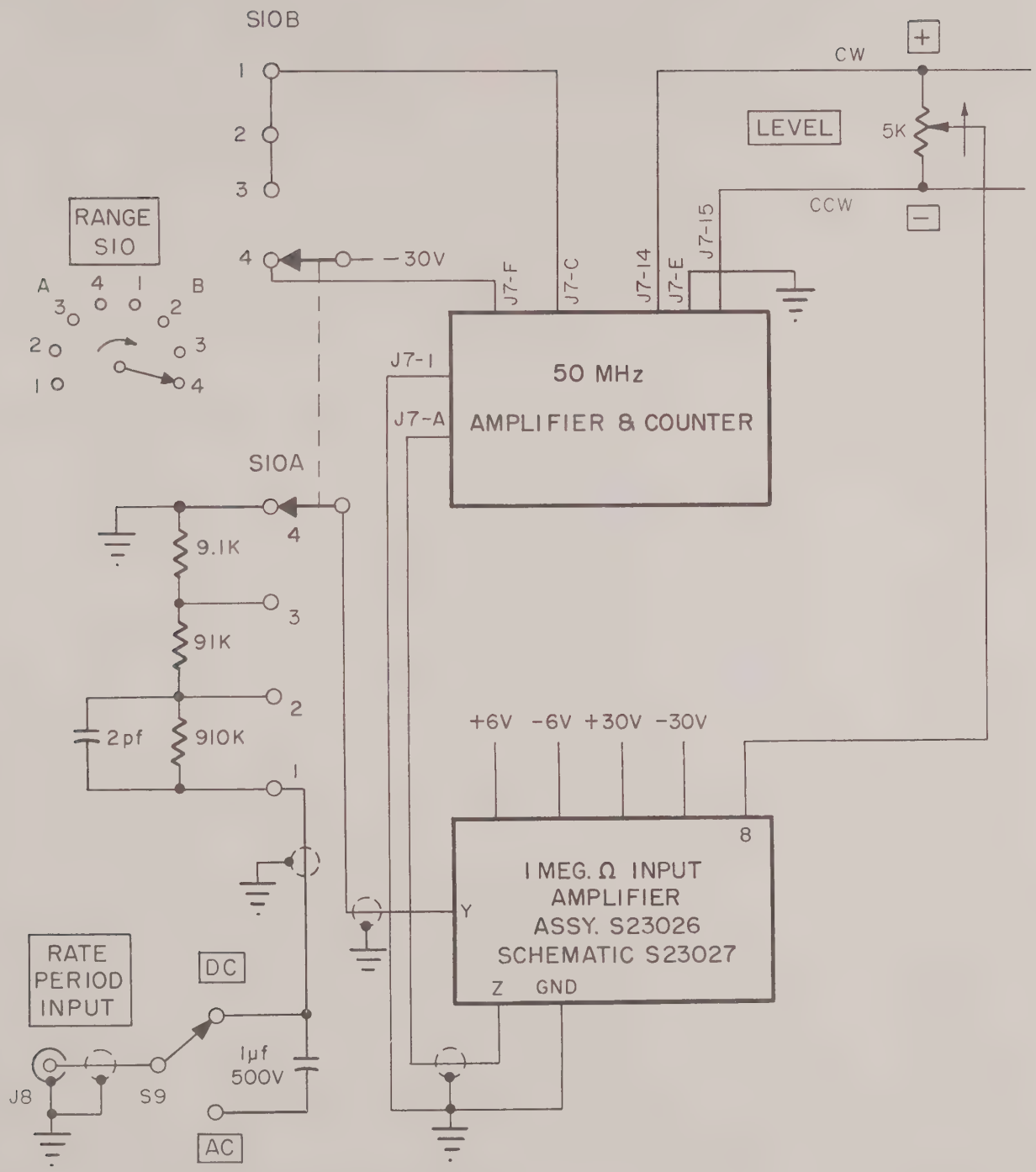



**FIGURE 4-25**

Detailed Block Diagram F Option

H. Option F

This option, by the addition of an FET amplifier circuit, increases the input impedance to 1 Megohm, shunted by 25 pF, on all attenuation ranges of the counter. (See Figure 4-25).

Two major circuit changes are involved: input attenuation circuits (except HET) are removed from the standard input amplifier and replaced by a voltage divider mounted directly on the RANGE switch, S10: and an FET amplifier (Assembly S23206) is connected between S10 and the "A" input of the Input Amplifier and Decade. Functional operation of the FET amplifier is as follows: (Refer to Schematic S23027). The attenuated input signal is applied to the gate of FET Q1. The amplifier input from the source of Q1 drives Q2 and Q3, the input side of push-pull amplifier (Q2, Q3, Q4, Q5). The FET differential amplifier (Q7 and Q8) through Q6, controls the trigger point of the push pull amplifier. The differential amplifier is controlled by the LEVEL control on the frong panel, through Pin 8, and by the feedback from the output at Pin 2. R12 is set to control the output of the amplifier when the input is zero.

## 4.4 50 MHz READOUT DECODER (Assembly 12979, Schematic 12978)

A. General Description

Refer to the detailed block diagram, Figure 4-26. The 50 MHz Readout Decoder board accepts the qui-binary logic outputs from the 50 MHz Amplifier and Decade board and translates them to bi-quinary logic form. The bi-quinary logic is applied to a readout indicator tube, whose dual plates and five dual-cathods translate the bi-quinary logic to decimal form and display it. The intelligence contained in the signals from the ring divider logic buffers is thus decoded and displayed in decimal form as the least significant digit in the readout indication.

All components except the transfer/store circuit-components, are mounted on a single plug-in printed circuit board, Assembly 12979. Refer to Drawing 12978 for the schematic diagram of this section. This assembly is common to both the standard SD 1017 Frequency Meter and SD 1037 Counter-Timer.

The major functional circuits are: 1) logic drivers; 2) quinary decoder; 3) ODD/EVEN decoder; and 4) transfer/store generator. The circuit components that generate the transfer/store signal are mounted on the Power Supply P.C. board (Assembly 19681).

B. Logic Drivers (Schematic 12978, Sheet 1 of 2)

Each input from the 50 MHz Amplifier and Decade board is fed directly to the base of a logic driver stage. The A, B, C, D, and E quinary inputs are alike only in that they swing above and below -6 volts to switch the drive transistors between the "on" to the "off" states. The input to Pin P400-10 is the binary signal from the ÷2 flip-flop and is handled in the same manner. It becomes the X and $\overline{X}$ signal at the logic drive outputs.

Since each of the logic driver stages are identical, the description of the S stage operation is applicable to the operation of all stages. When an input which is greater (more negative) than -6 volts is applied to the base of Q403, the transistor will switch to the "off" state, creating a logical "1" condition (nominally 0V) on the $\overline{X}$ line. As the collector of Q403 swings to 0 volts, the voltage at the base of inverter Q404

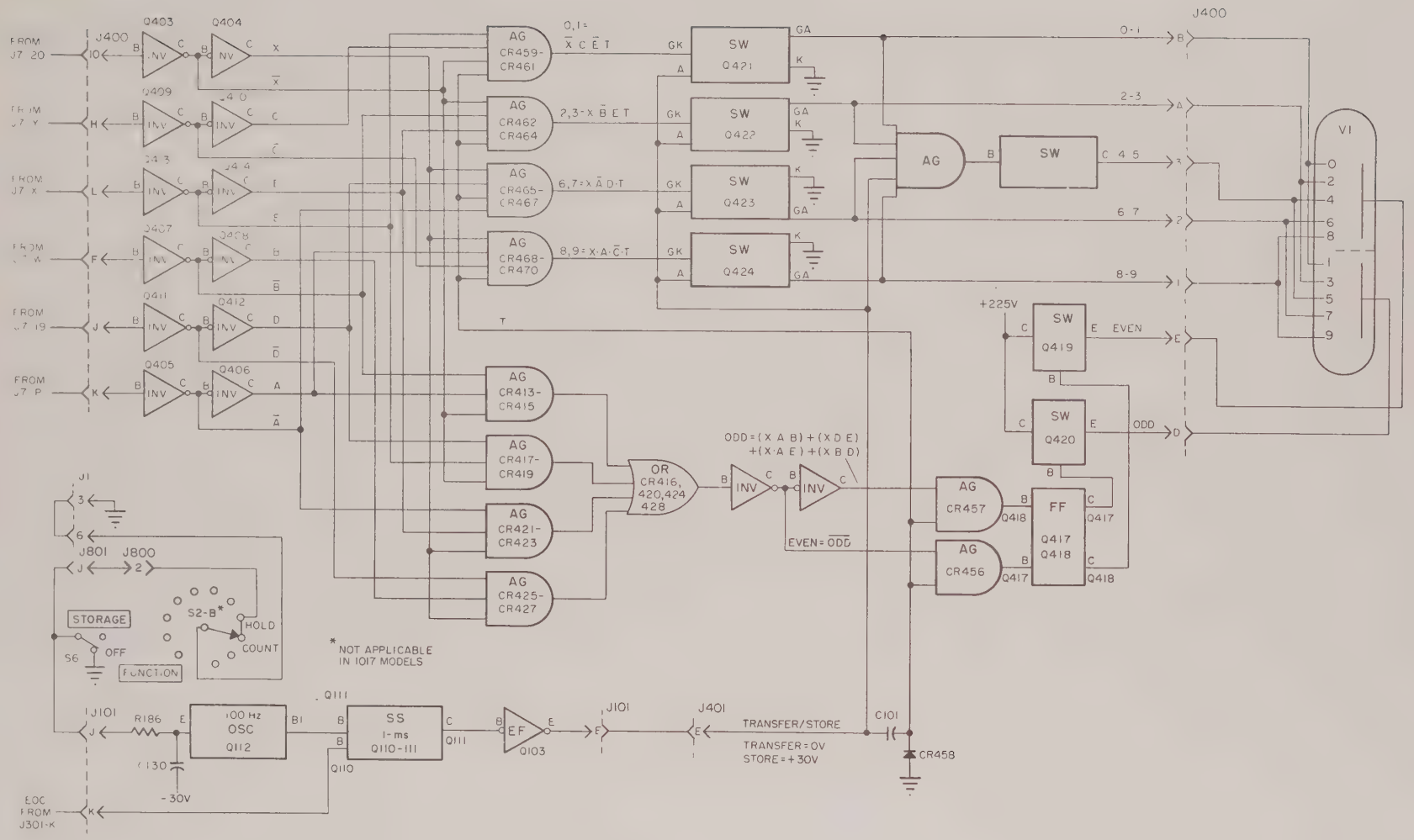



FIGURE 4-26

Detailed Block Diagram 50 MHz Readout-Decoder

falls below -6 volts and Q404 turns on, creating a logical "0" condition (nominally -6 V) on the X line. Conversely, with an input of less than -6 volts, Q403 turns off: creating a logical "0" condition on the $\overline{X}$ line; and raising the voltage at the base of Q404 above -6 volts - turning it on and creating a logical "1" condition on the X line.

### C. Quinary Decoder (Schematic 12978, Sheet 2 of 2)

Ten of the twelve logic lines (less B and D) from the logic driver stages are connected to four dual-cathode silicon-controlled-switches through four-input AND gates. This circuit is required to convert the "0,5; 1,6; 2,7; 3,8; and 4,9" quinary logic to 0,1; 2,3; 4,5; 6,7; and 8,9" form in order to drive the bi-quinary display tube. A common input to all gates from the transfer/store circuit permits either a continuous or cycling display of the input count.

To fire the SCS requires activation of the input AND Gate from the appropriate quinary logic inputs and the transfer pulse. See Figure 4-26 and 4-27. In the STORAGE mode of operation, a single-shot multivibrator in the power supply section generates a 1-millisecond negative pulse coincident with the end of the counting interval. This negative pulse removes the +30 V from the anode of the SCS causing it to turn "off" if it was previously "on". If the appropriate quinary logic inputs are present, 3 inputs of the input AND gate will be activated. The fourth input will not be activated (and the SCS will not turn on) until the transfer pulse occurs. This pulse is generated on the positive excursion of the storage waveform by the differentiator action of C101 and CR458.

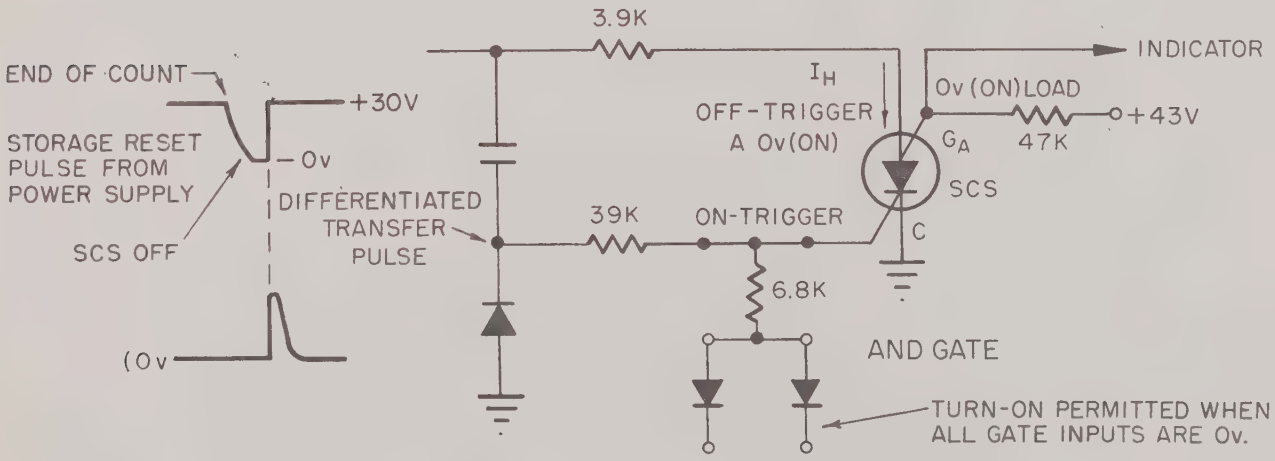



**FIGURE 4-27**

SCS Simplified Schematic Diagram

The SCS will remain "on" until the occurance of the next storage pulse.

In the STORAGE-OFF mode, the single-shot multivibrator is triggered by a unijunction transistor relaxation oscillator, free running at about 100 Hz. This produces a transfer pulse at 10-millisecond intervals and permits the readout to track the count when the count frequency is less than 100 Hz.

The STORAGE ON-OFF function is controlled by rear panel Switch S6.

The "4-5" information is obtained through a transistor switch driven by a five-input AND gate. Q432 will conduct whenever a storage/transfer pulse is received and none of the SCS's are conducting.

**D. ODD/EVEN Decoder (Schematic 12978, Sheet 2 of 2)**

Ten of the twelve logic lines (less C and $\overline{C}$) are connected to four three-input AND gates driving an OR gate to convert the "0-1-2-3-4" and 5-6-7-8-9" logic to "1-3-5-7-9" and "0-2-4-6-8" (odd/even) logic. The AND/OR gates decode only the ODD information, obtaining the EVEN information through an inverter stage, Q415.

The ODD/EVEN information is applied through two two-input AND gates to the SET and RESET terminals of a flip-flop stage, Q417-Q418. The output of the flip-flop stage is used to control two transistor switches, Q419 and Q420, to apply +225 V to the ODD or EVEN plates of the readout tube as appropriate.

**E. D and D2 Options (Schematics 15683 and 17021 B)**

When either of these digital output options is installed, additional decoders are required to convert the bi-quinary outputs of the 50 MHz Readout-Decoder (and also all subsequent decades) to the desired logic code. The bi-quinary information is available as negative logic at terminals R (0,1) P (2,3), N (4,5), M (6,7), L (8,9) D (EVEN), and C (ODD) of J2 for all decade boards.

For the D2 option, "1-2-2-4" positive logic is provided (+30 and 0V nominal) at rear panel connector J6. (See Schematic 17021). The decoders required (Schematic 17049) are mounted on separate PC boards and connected to the bi-quinary outputs of each decade.

**F. BCD Decoder (Assembly 15577, Schematic 12978, Sheet 2 of 2)**

When the D1 option is provided with the 1017/1037 instruments, the 50 MHz Storage Readout PC Board (12979) is replaced with Assembly 15577. This assembly differs only in that a bi-quinary-to BCD decoder circuit is provided. ( See Figure 4-28). AND/OR gates are used to decode BCD 2 and 4, and a single AND gate to decode BCD 8. The ODD information from Q416 is used to obtain BCD 1. The BCD outputs are connected to a rear-panel connector, J6 when this option is installed.

**G. Troubleshooting**

When a trouble has been traced to the 50 MHz Readout Decoder board, use the following procedure to locate the faulty components.

1) With the counter turned off, remove the 50 MHz board from its connector and replace with extender board. Insert 50 MHz board into extender and turn the counter on.

*NOTE*

*Do not re-insert 50 MHz board into the counter if the failure has resulted in one or more fuses being blown or smoke*

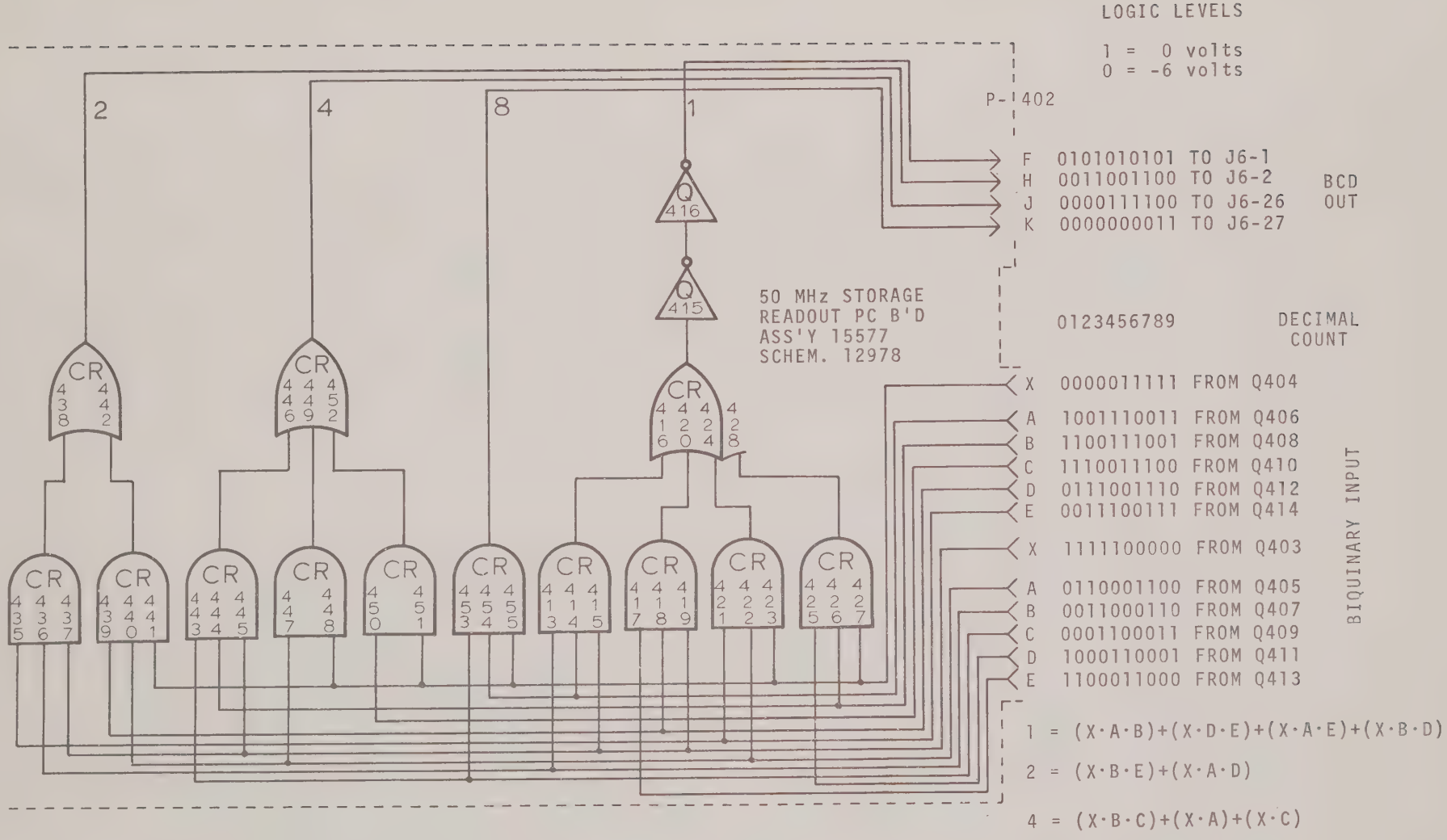



**FIGURE 4-28** Detailed Logic Diagram - Biquinary to BCD Translator (D-1 Option 1017,1037)

*rising from the counter. Visually inspect the board and use an ohmmeter to locate the failure.*

2) Place the FUNCTION switch in the COUNT position. (If the unit is a Model 1017 Frequency Meter, ground Pin J7-N instead, and place the FUNCTION switch in the RATE position).

3) Rotate the LEVEL control to the extreme counter-clockwise position (-). Depress the RESET switch.

4) Observing readout indicator tube V1, cycle the digits from zero to nine by rotating the LEVEL control to the extreme clockwise position (+) and back again to the (-) position for each successive digit.

5) Utilize the indications from V1 to establish which logic function has been affected by the failure.

## 4.5 DECADE COUNTING UNITS

### A. General Description

Systron-Donner counters use three basic counting units. These are the 10 MHz decade, the 2.5 MHz decade and the 250 kHz decade. The 10 MHz and 2.5 MHz decades use PNP transistors while the 250 kHz decade uses NPN transistors. Other than type of transistor, the decades are basically the same. Table 4-3 gives the assembly and schematic drawing numbers.

TABLE 4-3

| Decade Counting Units | | |
|---|---|---|
| DECADE | ASSEMBLY | SCHEMATIC |
| 10 MHz | 15200 | 15201 |
| 2.5 MHz | 11527 | 11528 |
| 250 kHz | 11523 | 11524 |

All components are mounted on a single plug-in printed circuit board. The major functional circuits are: 1) BCD Decade; 2) BCD-to-Bi-quinary decoder; and 3) odd/even decoder. The decoder sections of these assemblies are functionally identical to those of the 50 MHz Readout-Decoder except that the input is BCD "1-2-4-8" logic. Refer to Figure 4-29 for the Detailed Block Diagram of the 10 MHz Decade.

### B. BCD Decade (Schematic 15201)

The basic decade or decimal counting unit consists of four binaries which operate in a chain to produce one output pulse for every ten input pulses. At the same time, ten discreet states of collector voltage levels of the four binaries are obtained to produce a binary-coded decimal output (1-2-4-8).

Each binary is triggered into one of two stable states by its input pulses. In the "1" state, the left or odd-numbered transistor (relative to the schematic) conducts and the binary output level at the collector of the non-conducting transistor is -6 volts ("0" level). In the "0" state, the opposite condition exists and the output is 0 volts ("1" level).

The first three binaries have dual mode triggering through the parallel input steering diode connections and therefore change from one state to another on receiving successive positive pulses from the preceding stage or decade input. In dual mode triggering, one steering diode is cut off by the -6 volts at the collector of the non-conducting transistor. The positive input pulse passes through the other steering diode and cuts off the conducting transistor. The following positive pulse will not pass through the same diode because of the reversal of biasing. Binary A alternates with every input

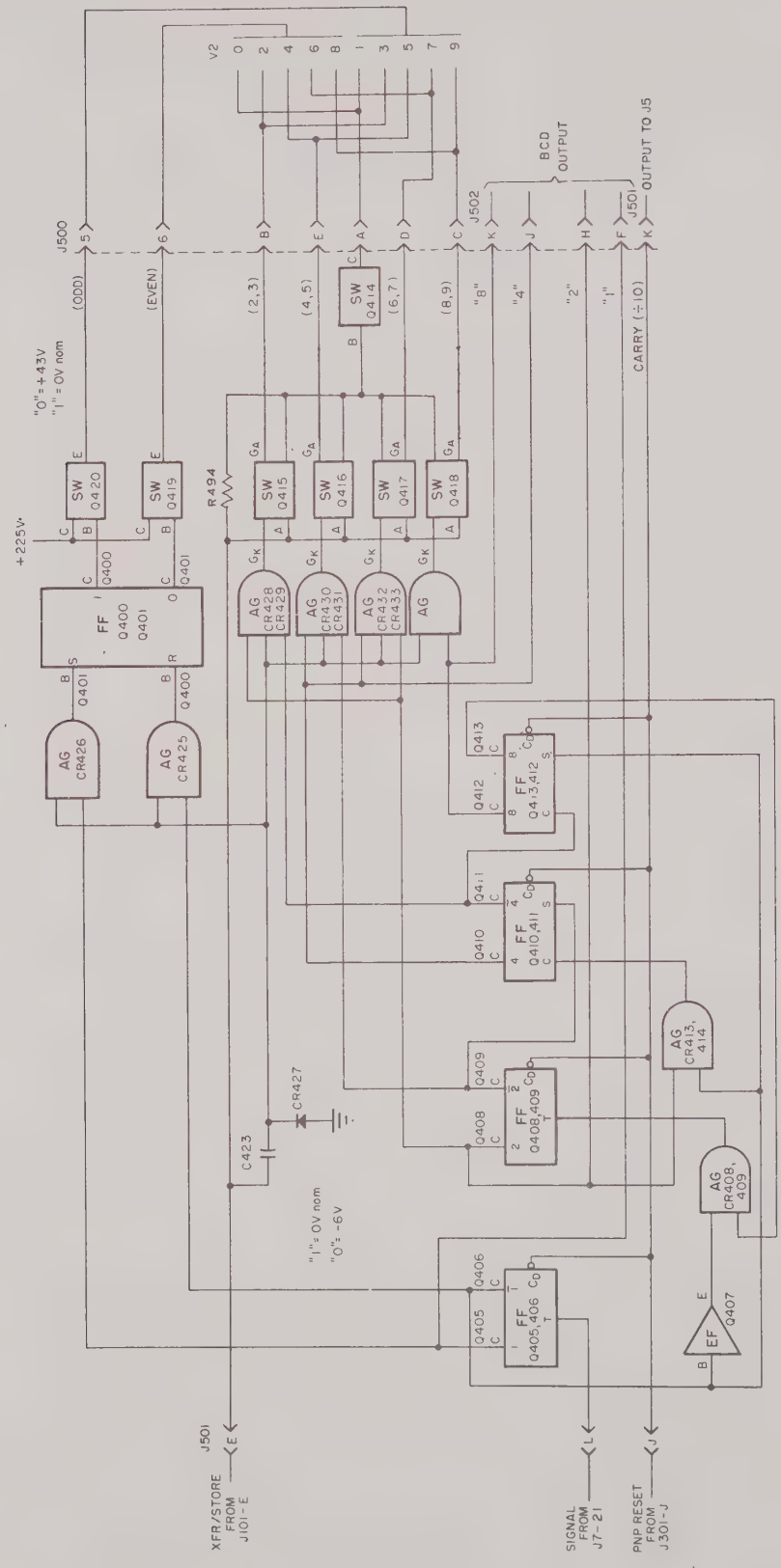



**FIGURE 4-29** Detailed Block Diagram 10 MHz Storage Decade

pulse or "count", Binary B with every second count (when not inhibited), and Binary C with every fourth count, Binary D has two single-mode trigger inputs: a) the output of Binary A, being coupled to the even numbered transistor, will cause it to trigger to the "0" state only; b) similiarly, the positive output of Binary C, being coupled to the odd-numbered transistor, will cause it to trigger to the "1" state only. A third special condition exists at the input to Binary B; c) feedback from the output of Binary D and the normal input form an AND gate. A positive input will pass only if the output of Binary D is negative. On counts 8 and 9, the output is positive, which prevents the next negative pulse from passing through the gate. Therefore, Binary B is inhibited from triggering at count "0". The complete sequence of events is shown in Figure 4-30. The arrows in the illustration indicate the triggering modes discussed above.

The 10 MHz and 2.5 MHz decades have additional circuitry to enable them to run at high speeds. This additional circuitry accomplishes the the following:

In order to reduce the effects of capacitive loading (distortion of the squarewave required for high frequency triggering) an emitter follower stage, Q507, is inserted at the output of Binary A. For the same reason, single mode triggering is used for Binary C. Binary B output, therefore, triggers Binary C to the "1" state on Count 4 by coupling through C511 to Q517. Binary C is triggered back to the "0" state by output of Binary A taken at the collector of Q506 and emitter follower output which couples through an AND gate to Q510 (C512 and CR513 paths).

The -6 volt or 0 volt binary output levels constitute a 1-2-4-8 binary code for the 0 to 9 count cycle. These voltages, as obtained from the collector of the left PNP or right NPN transistor of each binary (with reference to their location on the schematic) are used directly as the binary-coded decimal output at terminals F, H, J, and K of the connector (J402, J502, J602, etc).

### C. Troubleshooting

Once a problem has been isolated to a particular decade, troubleshooting is relatively straight forward. The sequence which follows will aid in isolating any problems.

*NOTE*

*When troubleshooting 250 MHz decades it is generally convenient to move the decade being worked on to the far right. This will give the decade a higher frequency input and make observation of waveforms much faster.*

1) Ascertain that the input to the decade is present and correct.

2) Check the normal and compliment outputs of each binary by placing an oscilloscope probe on the case of each transistor in the binary chain. The waveforms should correspond to those shown in Figure 4-30. The output from both sides of each binary will be identical in waveform but opposite in

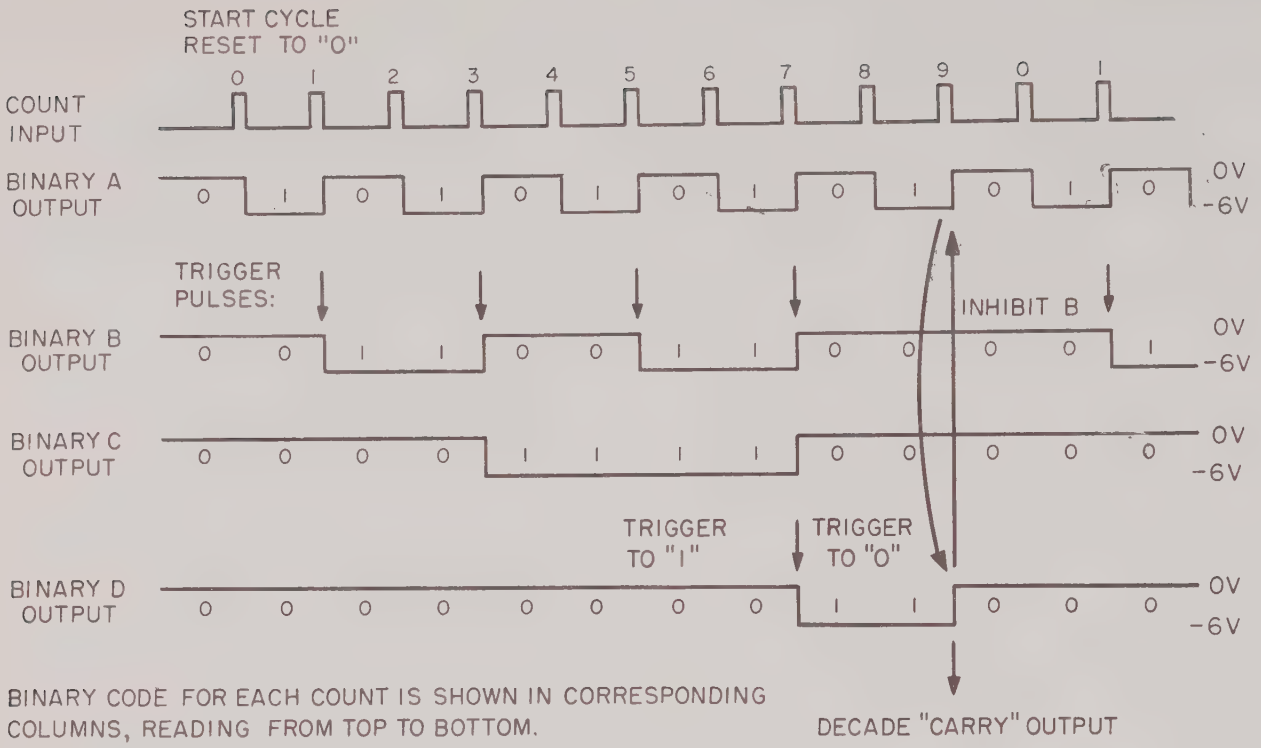



FIGURE 4-30

Timing Diagram, BCD Decades

polarity. If any of these outputs are missing or improper, repair the affected binary. Most problems will be caused by open or shorted diodes or transistors. Both of these devices may be checked with an ohmmeter without removing them from the circuit.

3) If the binary chain checks good but the indication is wrong, check in the following sequence:

a) Exchange indicators with a known good decade.

b) Step the decade through by placing the counter Count and applying the 1 pps time base output to the C input. Increase the time base rate one step at a time until the decade under observation is cycling at one number per second. Observation of which numbers are incorrect will localize the problem.

| OBSERVATION | PROBABLE CAUSE (250 kHz Decades) |
|---|---|
| Odd numbers only | Q600 or Q616 |
| Even Numbers only | Q601 or Q615 |
| 0,1 missing or continuous | Q610 |
| 2,3 missing or continuous | Q611, CR620, or CR621 |
| 4,5 missing or continuous | Q612, CR622, or CR623 |
| 6,7 missing or continuous | Q613, CR624, or Q625 |

| OBSERVATION | PROBABLE CAUSE (250 kHz Decade) |
|---|---|
| 8,9 missing or continuous | Q614 |

c) If the symptoms are unpredictable, check the storage transfer signal at Pin E and the differentiated signal.

## 4.6 DISPLAY AND RESET (Assembly 19243, Schematic 19244)

### A. General Description

The Display and Reset board contains the control circuitry for the counter. It generates the gate signal which controls the count interval, the reset signals, the end of count signal, and the print command signal. In addition the board contains two decade dividers which are used to generate the 1 and 10 second time bases (1037/1038) to generate the X10 and X100 functions.

All components are mounted on a single-plug-in printed circuit board, Assembly 19243, with the exception of the gate lamp driver, which is located on Assembly 19681, Power Supply PC board. The functional circuits are: 1) Control Binaries; 2) Reset Circuits; and 3) Gate Lamp Control. Figure 4-31 is the Detailed Block Diagram for this unit.

### B. Control Binaries (Schematic 19244)

The output pulses from the input amplifiers and from the time base circuitry are applied to the start and stop inputs of the control binaries. These inputs respond only to positive-going input pulses by virtue of diodes CR9 and CR12.

Assuming that the control circuitry is in the "reset" condition (all indicator tubes register "0"), a positive "start" pulse applied through C10 turns off Q3 and turns on Q4 in the binary circuit. The positive-going output at the collector of Q4 turns Q5 off and Q6 on in the following binary. Consequently, a high (zero volt gate level output occurs at Terminal F which opens the gate and causes the decimal counting units to cycle, provided that there is a "count" input signal present. If a stop pulse were received prior to the "start" pulse, this would tend to turn off the already-off Q4, preventing the count from starting.

When a positive "stop" pulse arrives, only binary Q5/Q6 flips, causing the Gate level output to change to a -6 volt (gate closed) level, as limited by CR31. Because the collectors of both Q3 and Q6 are not at zero potential, a +10 volt potential is applied through R52, turning off Q14 (an NPN type transistor), and producing a -6 volt End-of-Count Signal at terminal K which is connected to the blanking-storage gate in the power supply. At the same time, Q10 is turned off and initiates the reset signal, after a delay, for the display interval.

### C. Reset Circuits (Schematic 19244)

When Q10 is turned off by the "stop" pulse, Capacitor C8 charges up towards +30 volts through the series network which includes R17 and the DISPLAY time control. When the voltage rises to the peak point of Q11, this unijunction transistor fires and causes C8 to discharge. The resulting pulse across R8 drives the reset pulse circuitry. The output of Q12 resets the start-stop binaries.

The display time delay interval is determined by the rate of charge of C8 and

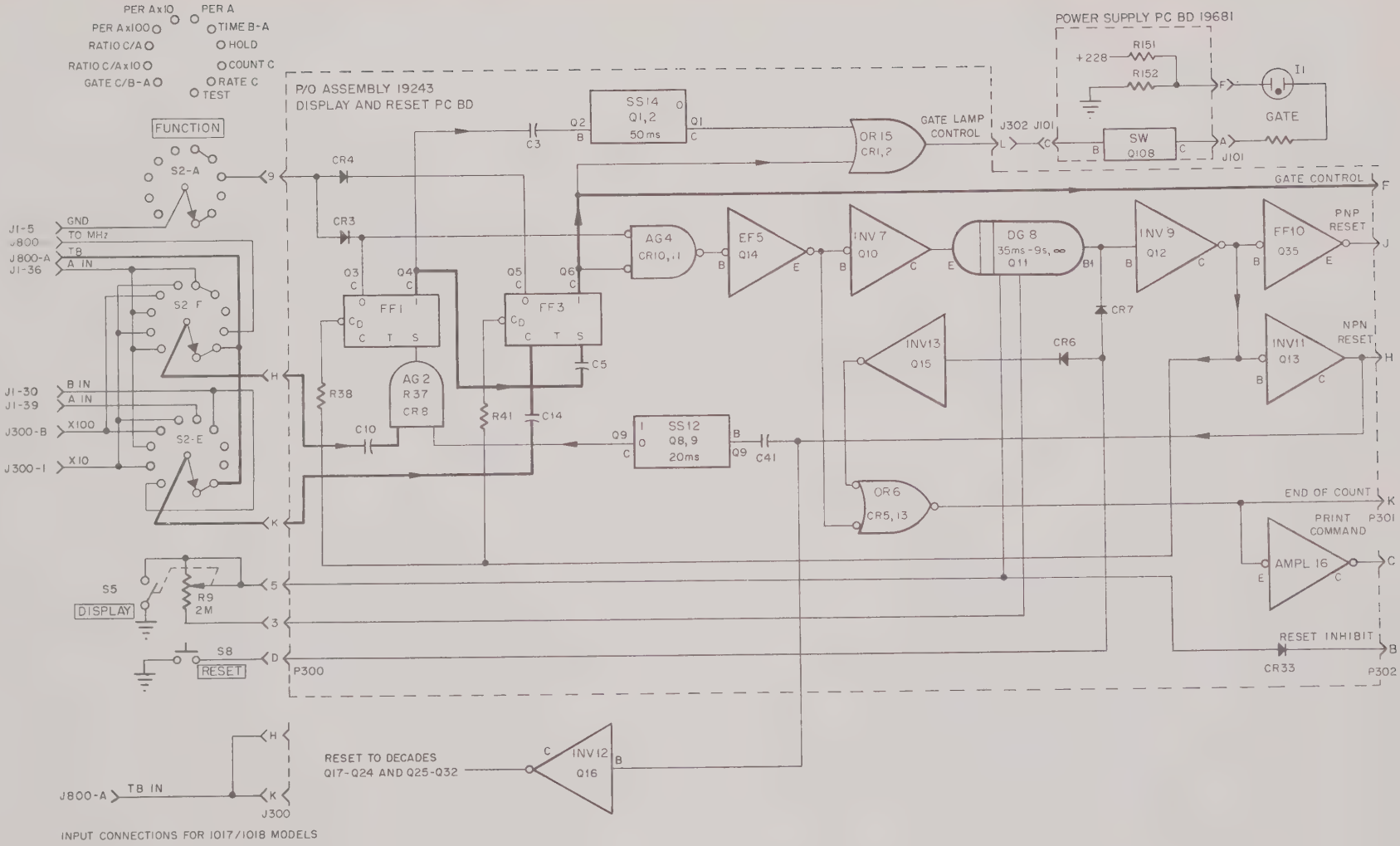



**FIGURE 4-31** Detailed Block Diagram Display and Reset

can be adjusted by the DISPLAY control. When the DISPLAY control switch is in the "infinite" position, the charge path is opened and will never charge so that a manual reset pulse is required to effect counter reset.

Similarly, no reset will occur if terminal B (P302) is externally grounded. By this means, an external printer or digital voltmeter can inhibit reset until its cycle of operation has been completed.

The ground potential which occurs at terminal C (P302) when Q7 turns on may be used as the print command signal to initiate the operating cycle of an external printer.

The decade units are reset by the NPN reset signal after inversion by Q16. The output of Q13 triggers a one shot Q8/Q9 which inhibits the start input through CR9 until the one-shot returns to its normal condition after approximately 20 milliseconds delay. This action assures that no start pulse will open the gate until all circuits in the counter are reset.

Figure 4-32 illustrates the timing waveforms.

### D. Gate Lamp Control (Schematic 19244 and 23478)

At gate "start" time, the positive going output at the collector triggers a 50 ms single-shot (Q1,Q2). The positive output from Q1 of this single-shot is coupled through an OR gate (CR1, CR2), turning on switch transistor Q108 (on power supply PC board) and lighting the GATE lamp. The lamp will remain lit until the single-shot completes its cycle or until gate "stop" occurs (Q6 collector goes negative), whichever is later. The single shot ensures a 50-millisecond gate lamp "ON" time regardless of the counter gate width.

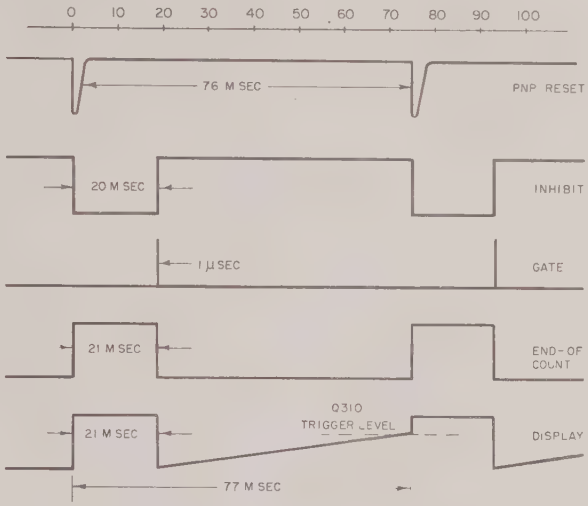



**FIGURE 4-32** Waveforms (Shown for 1 microsecond time base in TEST function with DISPLAY control at fastest rate).

### E. D1, D2 Options

Whenever either of these digital output options is installed, a Print Command and Inhibit Reset Assembly (16129 for D1, 16030 for D2) board is installed in the counter and connected to the display and Reset board as shown in Figure 4-33.

The end-of-count signal turns Q7 "ON" driving J302-C from +30 to 0V and this negative transition is delivered as the "print-command" to the external printer through a 1 k resistor on the print-command and inhibit reset assembly. Provision is made to inhibit reset in the instrument until the external printer completes its cycle of operation. This is accomplished by grounding J302-B through a 2.7 k resistor on the print command and inhibit reset board. This inhibits Q11 from generating the reset pulse until the inhibit reset terminal (J6-47) is opened.

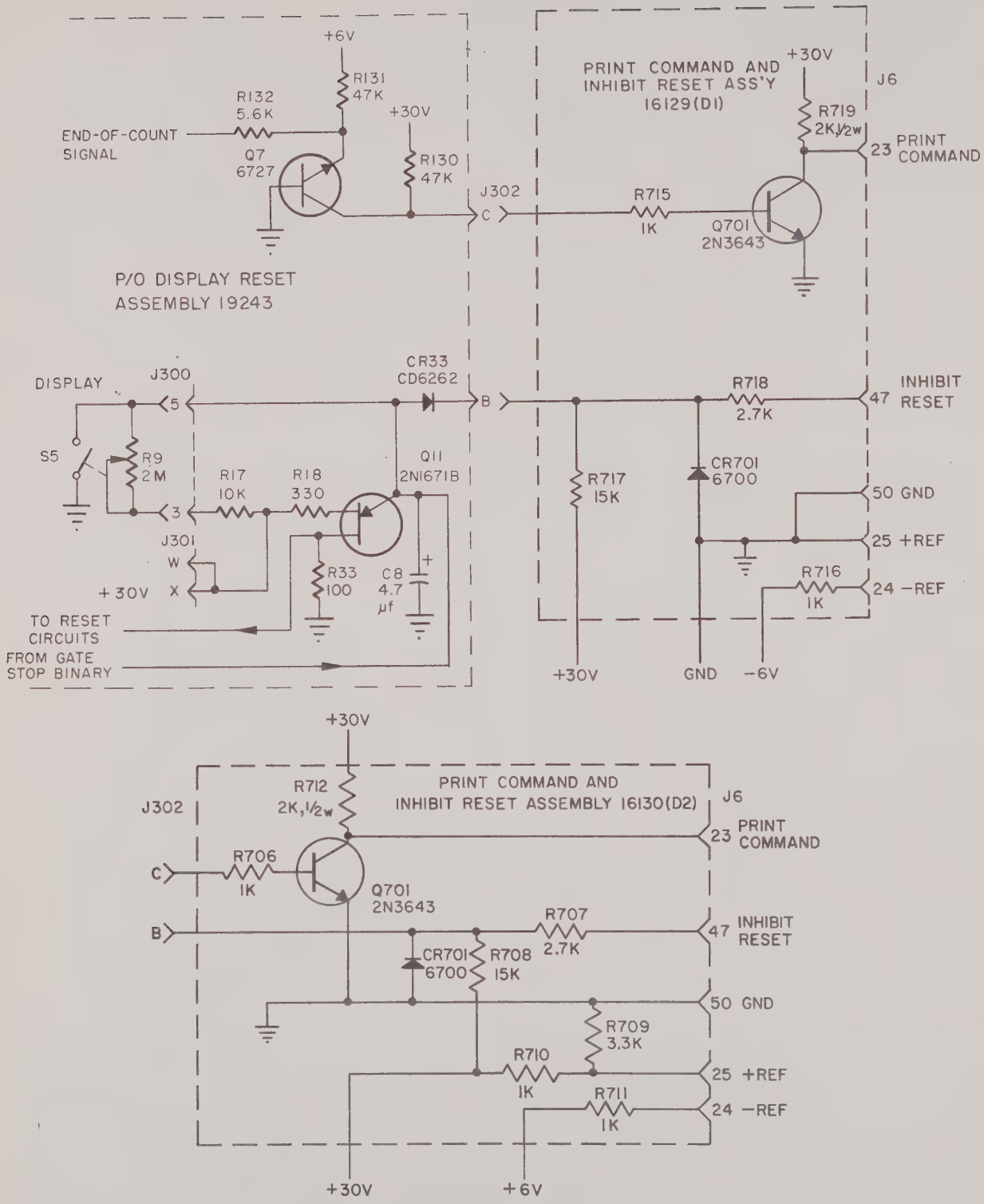



**FIGURE 4-33**

Print Command and Reset Inhibit

### F. Troubleshooting

Fault location is best approached by beginning with the basic inputs to the Display and Reset board, the START and STOP signals. Use the following sequency of checks:

1) Place the counter in TEST, set the TIME BASE to $10^{-3}$.

2) Are Time Base Pulses present at J300-H and K? If they are, check for the following outputs:

| OUTPUT | PINS | TYPE OF SIGNAL |
|---|---|---|
| Control Gate | J301-F | Rectangular--from -6 V to 0V. 0V time same as time between start-stop pulses. |
| PNP Reset | J301-J | Pulse from 0V to -6 V approximately 75 ms apart. |
| NPN Reset | J301-H | Pulse from -6 V to 0V. |
| End of Count | J301-K | Rectangular--from 0V to -6 V. |

3) If any or all of the signals are missing, check as follows:

NPN Reset (all others present) - Check Q13

Both Resets missing - Check Q11, Q12

End-of-Count missing - Check Q14

Control Gate missing - Check binaries Q3, 4, 5, 6)

4) Should the above procedures fail to locate the problem a study of the schematic diagram, bearing in mind the circuits that have been eliminated should locate the faulty circuit.

## 4.7 OSCILLATOR AND MULTIPLIER

### A. General Description

Systron-Donner 1000-series counters employ four basic oscillator assemblies and two multiplier boards. Table 4-4 gives the assembly and schematic drawing numbers for each case.

TABLE 4-4
OSCILLATOR-MULTIPLIER TABULATION

| OPTION | OSCILLATOR | | MULTIPLIER | |
|---|---|---|---|---|
| | ASSEMBLY | FREQUENCY | ASSEMBLY | SCHEMATIC |
| STANDARD | Y0023 | 1 MHz | 17966 | 17970 |
| B3 | 33239 or 33428 | 3 MHz | 17596 | 17597 |
| B | 33238 or 33427 | 3 MHz | 17596 | 17597 |
| B4 | 33240 or 33429 | 3 MHz | 17596 | 17597 |

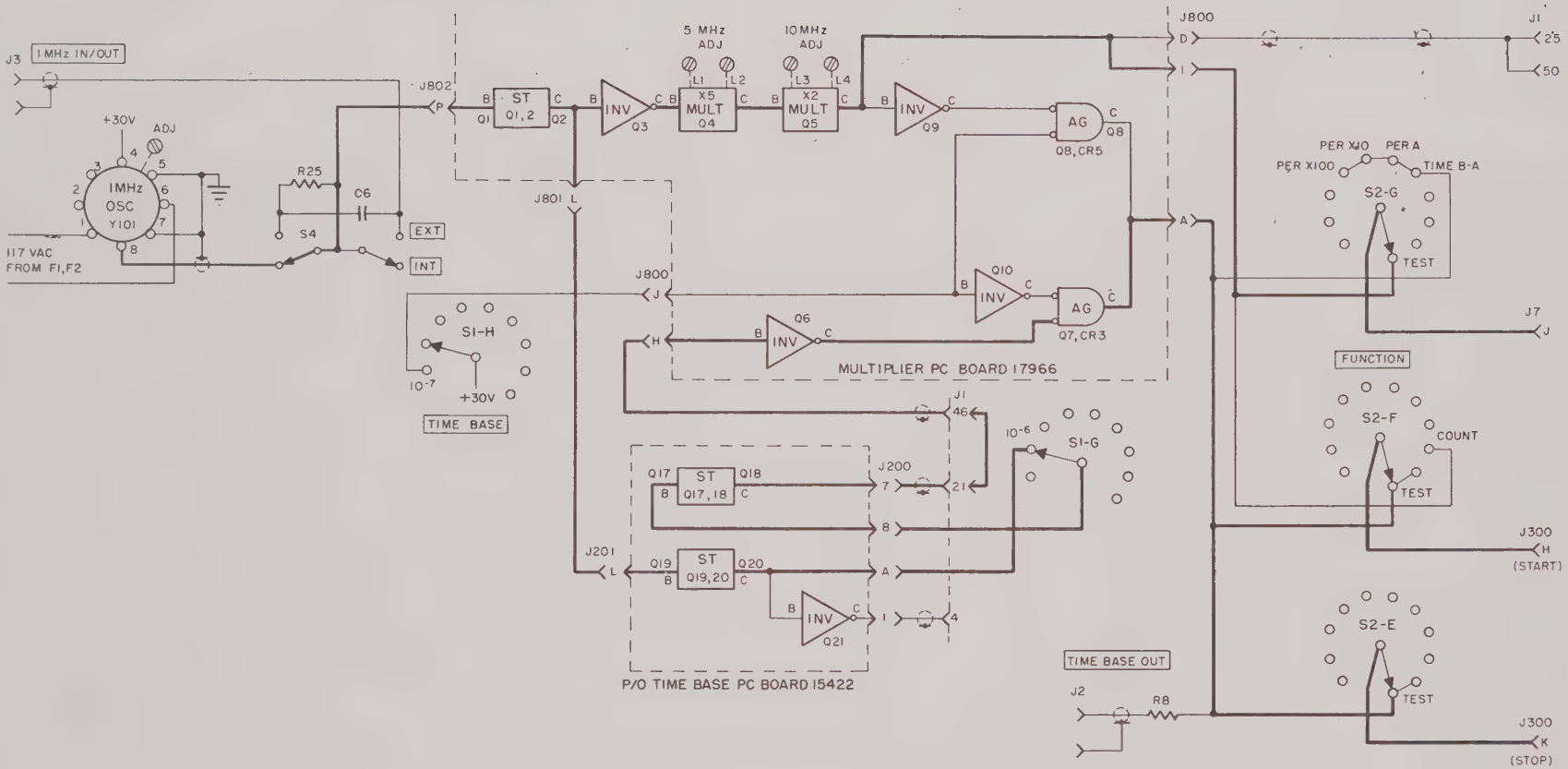



**FIGURE 4-34** Detailed Block Diagram Oscillator and Multiplier

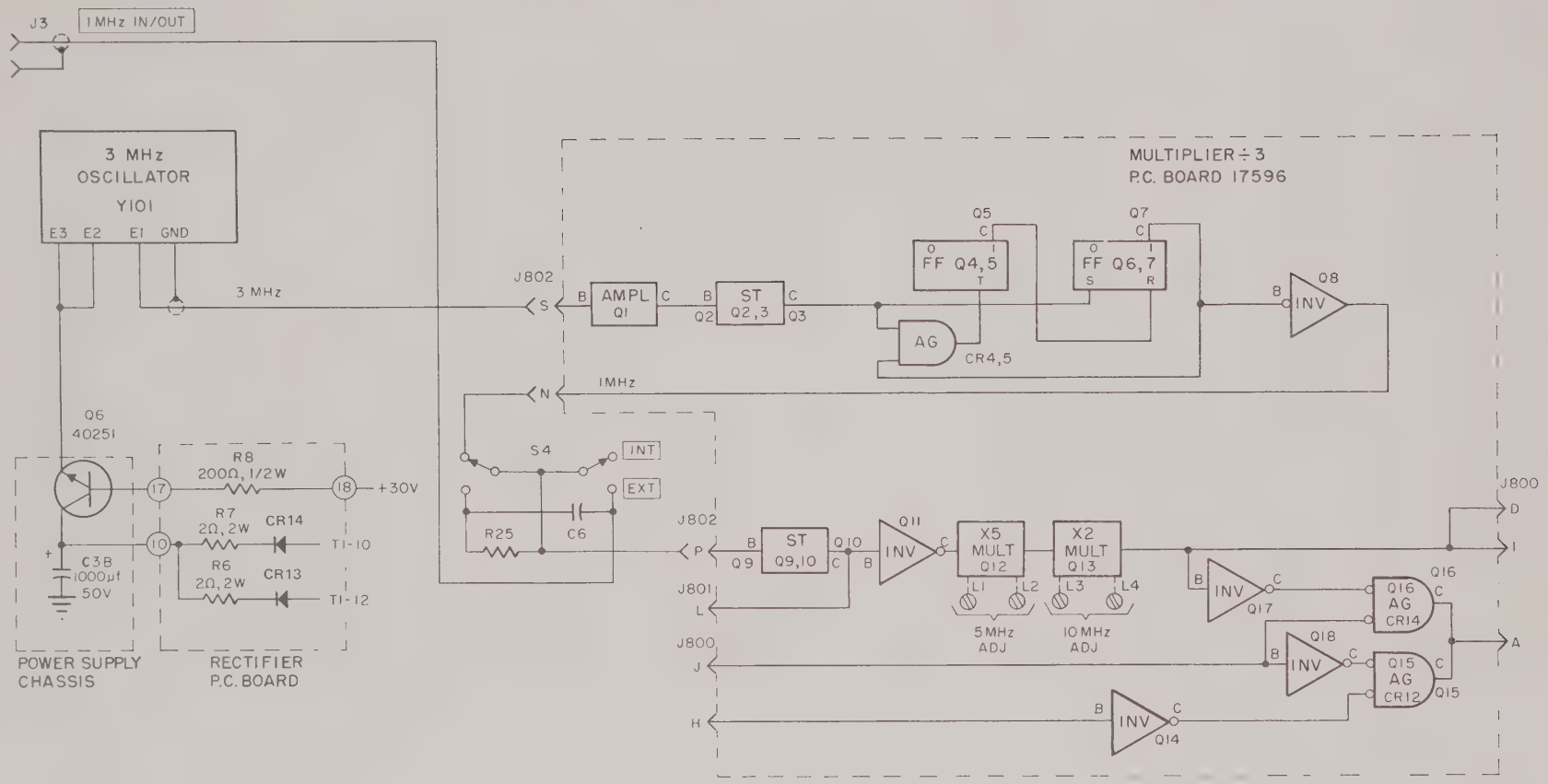



**FIGURE 4-35**

Detailed Block Diagram B, B3 & B4 Option
Oscillator & Multiplier

The oscillator assemblies differ in their stability, source of operating power, and operating frequency (Refer to Figures 4-34 and 4-35). The multiplier assemblies differ only in that a divide-by-three circuit is provided for the 3 MHz oscillator options (B3,B,B4).

The oscillator assemblies are sealed units; all components of the multiplier assemblies are mounted on a single plug-in printed circuit board.

The major functional circuits for the oscillator are: the oscillator, the divide-by-three circuit (Options B3, B and B4), the multiplier circuit and the time base select circuit.

**B. Oscillator Circuits (Figures 4-34 and 4-35)**

The standard oscillator (Y0023) provides a 1 MHz output which is routed through the rear-panel INTERNAL-EXTERNAL switch (S3) to the multiplier circuit. The standard oscillator requires +30 volts (operation) from the power supply board and 117 volts ac (oven power) from the input primary power line. The B3,B and B4 oscillator options require a +28 volt dc source. An additional rectifier and regulator circuit, located on the rectifier board and power supply chassis, are provided whenever the B3 or B option is installed. The B4 "super high stability" oscillator requires an additional regulator circuit (Assembly 25957) for a more constant +28 volt dc source. The 3 MHz output signal (B3,B and B4 options) is routed to an amplifier and shaper circuit, a divide-by-three circuit and then through the rear-panel INTERNAL-EXTERNAL switch to the multiplier circuit (Refer to Figure 4-35).

**C. Multiplier Circuit (Figure 4-34)**

The 1 MHz output from the standard oscillator is connected, via J802-P, to a Schmitt trigger, Q1 and Q2. The output from Q2 is used as both the 1 MHz ($10^{-6}$) time base signal and as the drive for the X10 multiplier (Q4 and Q5). The 10 MHz output from Q5 provides the count signal in the TEST function and the time base signal in the $10^{-7}$ position of the TIME BASE switch.

**D. Divide-by-Three Circuit (Figure 4-35)**

The 3 MHz signal (B3,B or B4 oscillator) at J802S is amplified by Q1. The output (collector) of Q1 is applied to the base of Q2, which, with Q3, forms a Schmitt trigger. The shaped output from the trigger is applied to the divide-by-three circuit. The divide by three circuit consists of two flip-flop circuits (Q4-Q5 and Q6-Q7). The first has dual input gating and divides the 3 MHz input by two. The second has separate inputs: a 3 MHz input and the output of the first flip-flop. The 3 MHz input coupled to Q6 turns that transistor on, the next two pulses have no effect as the transistor is already turned on. At the third pulse the Q4-Q5 flip-flop switches and turns Q7 on, which in turn turns Q6 off. The next 3 MHz pulse turns Q6 on again and the cycle repeats. The net effect is that one output pulse (at the collector of Q7) occurs for every three input pulses.

The output pulse, now 1 MHz, is applied to Q8, an amplifier. The output of Q8 is routed via J802-N to the multiplier circuit.

**E. Time Base Select (Figure 4-34)**

The selector circuit determines which time base is available for use as a start-stop signal and as a front panel

output. The circuit is basically composed of two amplifiers and an electronic switch.

Q6 amplifies the selected time base and applies it to the base of Q7 which is the normally closed side of the switch. Q9 amplifies the 10 MHz output and applies it to Q8, the normally open side of the switch.

Switch (Q7 and Q8) operation is controlled by the voltage, or lack of voltage, at P800-J. In all positions of the TIME BASE switch (S1 wafer H) except $10^{-7}$ (10 MHz) there is no voltage applied to P800-J. Under these conditions Q7 is free to conduct and passes the time base signal to P800-A. At the same time Q8 is prevented from conducting by the positive bias applied to its base by Q10. Q10 is turned on by its fixed bias and will remain so until turned off by a positive voltage applied to P800-J. When the TIME BASE switch is placed in the $10^{-7}$ position, +30 volts is applied to P800-J. The +30 volts will turn Q10 off, which, in turn, will allow Q8 to conduct and pass the 10 MHz signal to J800-A. At the same time the +30 volts is applied to the base of Q7 - turning it off and preventing the time base (from Q6) from passing through the switch.

## F. Troubleshooting

Troubleshooting of the multiplier board is relatively straight forward as the board is divided into three separate functions making isolation of a fault a simple task. Typically any problem on the multiplier board will evidence itself by the loss or distortion of one of the board outputs.

1) Loss or distortion of 1 MHz output (P801-L)

a) Check for the presence of 1 MHz at P802-P

b) Check the collectors of Q1 and Q2. Check the emitter of Q3.

Normally, the problem will be caused by one of the three transistors.

2) Loss or Distortion of 100 MHz Output (P800-J)

a) Check for the presence of the 1 MHz signal at the base of Q4.

b) Check the adjustment of the multiplier. A 5 MHz signal should be present at the collector of Q4.

c) If the transistors (Q4 and Q5) check good, check the tunable inductors. Look for broken leads or cracked tuning slugs.

d) Ascertain that Q9 is not bad and loading the circuit.

3) Loss of 10 MHz Output (P800 C and C)

a) If the 10 MHz signal is present at the collector of Q5 then L5 is misadjusted or defective.

4) Loss of Time Base Output (P800-A)

a) Check for presence of TIME BASE at P800-H and for 10 MHz at the collector of Q9.

b) With the TIME BASE switch in any position except $10^{-7}$, check for the presence of the time base at the base of Q7.

c) With the TIME BASE switch in $10^{-7}$, check for the presence of +30 volts at P800-J. If +30 volts is present, but there is no 10 MHz output, check Q10.

Troubleshooting of the oscillator assembly consists of observing the output waveform and frequency, checking the input dc and ac operating voltages, and making periodic adjustments as described in Chapter 5 of this manual. Should a failure occur, do not attempt to repair this unit; contact your nearest Systron-Donner field office.

## 4.8 TIME BASE (Assemblies 15422 and 19243; Schematics 15423 and 19244)

### A. General Description

The Time Base functional section provides all of the time base frequencies used in the instrument and in the case of the 1037/1038 counter-timers, provision is made to divide the "A" signal by 10 or 100 for the multiple-period and RATIO functions.

The decade chain of the Time Base functional section provides the following time base frequencies:

TABLE 4-5

| TERMINAL | OUTPUT FREQUENCY | PERIOD |
|---|---|---|
| J200-A | 1 MHz | $10^{-6}$ sec. |
| J200-4 | 100 kHz | $10^{-5}$ sec. |
| J200-6 | 10 kHz | $10^{-4}$ sec. |
| J200-B | 1 kHz | $10^{-3}$ sec. |
| J200-C | 100 Hz | $10^{-2}$ sec. |
| J200-5 | 10 Hz | $10^{-1}$ sec. |
| J300-B | 1 Hz | 1.0 sec. |
| J300-1 | 0.1 Hz | 10 sec. |

The TIME BASE and FUNCTION switches select and route these frequencies to start and stop the counter gate or to be used as the count frequency depending on the function selected.

All components are mounted on a single plug-in printed circuit board (Assembly 15422) except the 1 Hz and 0.1 Hz decades which are located on the Display and Reset board (Assembly 19243).

Refer to Figure 4-36 Detailed Block Diagram, Time Base Dividers. All decades are functionally the same, differing only in their operating speed. Each decade consists of four flip-flop stages connected in the BCD decade mode. The timing of these decades is identical to that shown in Figure 4-30. The 100 kHz through the 10 Hz decades run continuously; the 0.1 Hz and 1 Hz decades are reset to "9" from the NPN reset circuitry so that each will produce an output pulse when the first input pulse is received. This is done in these two decades to avoid the long counting delay that would result if they were reset to "0". A single-shot circuit (Q33, 34) is used to inhibit the inputs to these decades to ensure that they will not be triggered until reset action is complete.

In all positions of the FUNCTION selector except the X100 functions, the input to the X100 decade is the 10 Hz time base signal. This circuit, therefore, produces the 1 Hz time base at the output. In all functions except X10 and X100, the 1 Hz output of the X100 decade is applied to the X10 decade which produces the 0.1 Hz time base outputs.

### B. Troubleshooting

Fault location in the Time Base section is very straight-forward if the proper troubleshooting sequence is followed. Troubleshoot as follows: (Refer to Figure 4-36).

1) Check for presence of 1 MHz input at J201-L.

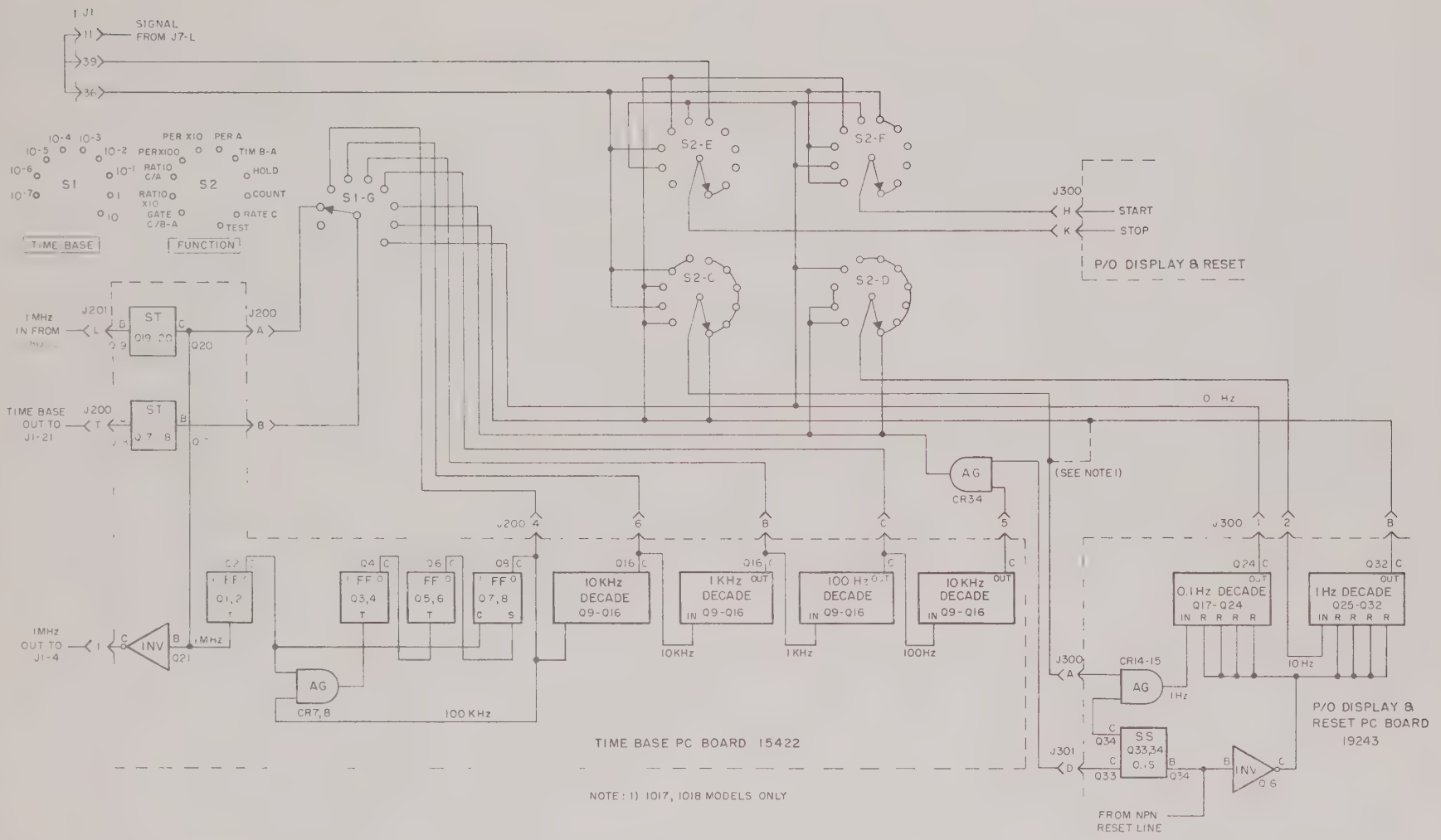



FIGURE 4-36 Detailed Block Diagram Time Base Dividers

2) Check for the presence of the 1 MHz output at J200-A and J200-1.

3) Check the following in turn: (TEST) function, 10 sec, TIME BASE)

| | |
|---|---|
| J200-4 | 100 kHz |
| J200-6 | 10 kHz |
| J200-B | 1 kHz |
| J200-C | 100 Hz |
| J200-5 | 10 Hz |
| J300-B | 1 Hz |
| J300-1 | 0.1 Hz |

4) Check for presence of selected time base at J200-8.

5) Check for presence of time base output at J200-7.

## 4.9 POWER SUPPLY (Assembly 19681, 15670, 15401; Schematics 25344, 23478)

### A. General Description

Physically, the power supply is divided into two sections; the Power Supply Assembly and the Power Supply Regulator Card. The Power Supply Assembly is located in the rear right hand corner of the counter and contains the transformer, filter capacitors, fuses, rectifiers and series regulator transistors for all of the supplies. The Power Supply Regulator Board is the first plug-in card at the right and contains the regulator amplifiers, their associated components, the gate lamp circuit and the storage reset circuit.

The power supply produces 8 regulated DC voltages. The voltages and their primary uses are listed in Table 4-5.

TABLE 4-5
Power Supply Output Voltages

| VOLTAGE | CURRENT | USE |
|---|---|---|
| +30 V | 500 mA | Transistor biasing |
| -30 V | 500 mA | Transistor biasing |
| +6 V | 500 mA | Transistor biasing |
| -6 V | 500 mA | Transistor biasing |
| +225 | 50 mA | Indicator tube B+ |
| +43 V | 5 mA | Indicator tube biasing |
| +20 V | 10 mA | Plug-in unit (derived from +30V) |
| -15 V | 50 mA | Plug-in unit (derived from -30V) |

Except for the +43 volt supply, all power supplies are fused. The fuses are located at the rear of the plug-in compartment and are readily accessible with the plug-in unit removed.

*WARNING*

*DANGEROUS VOLTAGES ARE PRESENT AT THE FUSES. REMOVE ALL AC POWER TO THE INSTRUMENT AND WAIT AT LEAST TWO MINUTES BEFORE REMOVING ANY FUSE.*

Fuse values are listed below.
All fuses are 3AG, quick acting types, do not attempt to use SLO BLO type fuses in the DC power supply.

| | VOLTAGE | | | | |
|---|---|---|---|---|---|
| Fuse Value | +30V | -30V | +6V | -6V | +225V |
| | 1A | 1A | 1A | 1A | 1/4A |

There are two major functional circuits; 1) Rectifier-Filters; and 2) Regulators. Figure 4-37 is the Detailed Block Diagram for the power supply. See Chapter 2 of this manual for 230 VAC operation.

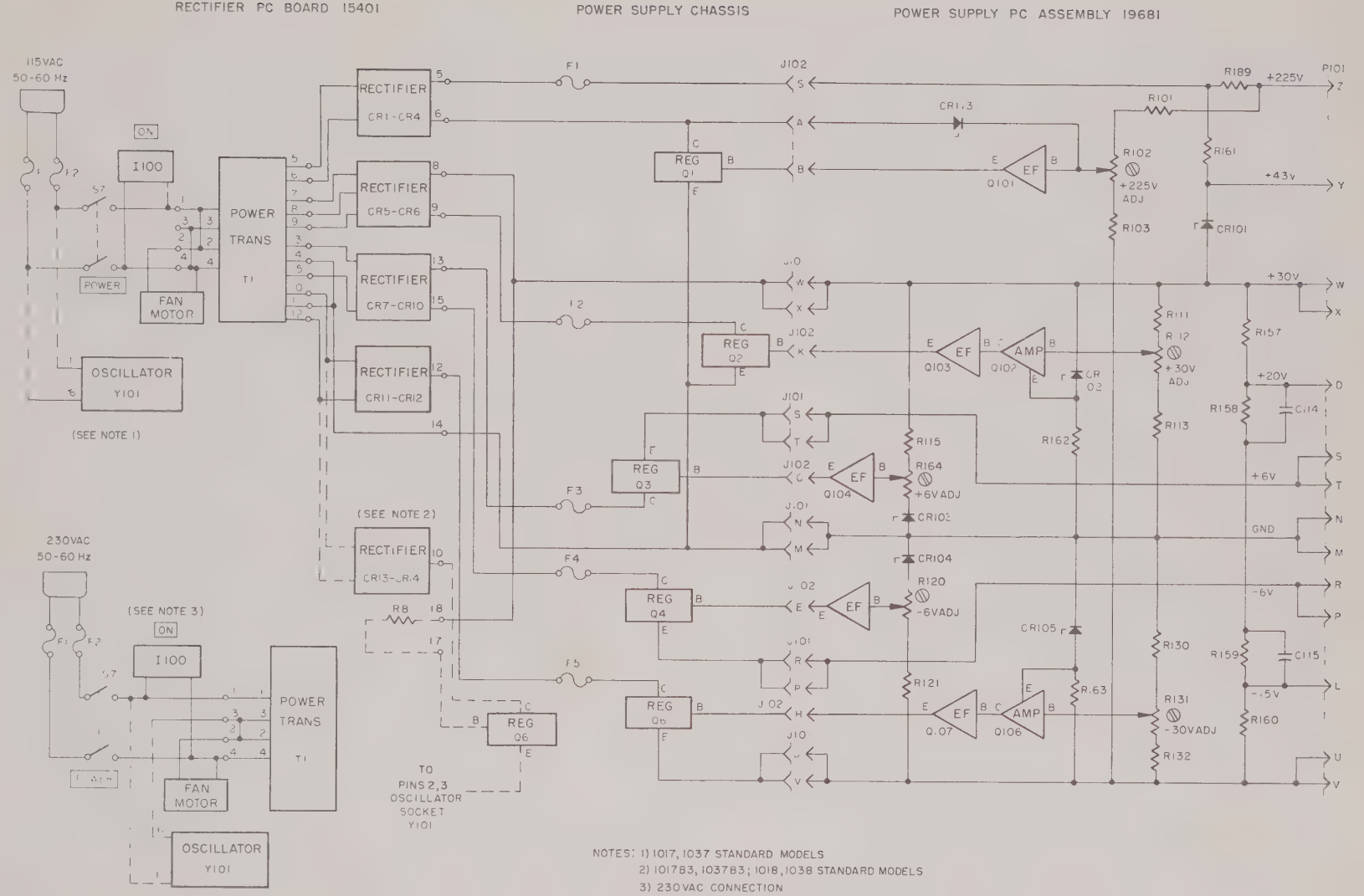



FIGURE 4-37 Detailed Block Diagram Power Supply

B. Transformer and Rectifier-Filters

The transformer (T1) has four windings; three low voltage-high current and one high voltage low current. Drawing #23478 gives data pertinent to the transformer. Figure 4-38 gives the location and layout of the transformer connections.

Rectification and filtering are identical for all low voltage supplies (+30 V, -30 V, +6 V and -6 V). Each supply uses a full wave rectifier followed by a 2 ohm, 5 watt series resistor; a 1000 µF filter capacitor is connected across the supply to ground and a fuse is inserted in the line. From the fuse the rectified-filtered AC goes to the regulator circuitry located on the plug-in card. (Assembly #19681).

The +225 volt supply departs from the basic scheme in that it uses a full wave bridge rectifier, followed by a 10 ohm resistor and 33 µF filter capacitor.

C. Regulators

The +30 V, -30 V, +6 V, and -6 V outputs are obtained from individual voltage regulator sections, but common in operation. Using the -30 V section as an illustration, a full-wave diode rectifier (CR11 and CR12) generates an unregulated 40 volts which is applied to an "L" filter consisting of R5 and C5. The filtered DC passes through a series regulator (Q5), a type 2N2138 transistor, to the output terminal. The regulator is controlled by degenerative feedback from the regulating amplifier, Q106 and Q107, and acts as a variable impedance device which compensates for changes in output voltage level. At a stable condition, the voltage at the arm of R131 of the output divider network is virtually zero with respect to the fixed bias level (at the emitter of Q106) created by Zener diode CR105, which is the prime reference for the supply. When the output level drifts, and error voltage at the arm of R131 is sensed by the regulating amplifier. The degenerative loop action of the amplifier tends to reduce the error voltage to zero again. The output voltage level can be varied by changing the setting of R131. Output regulation is maintained to within 2%.

The +30 V power supply is identical except that the circuit is grounded at the low side, which shifts the high side to a +30 V level.

In the +6 V and -6 V supplies, Q3 and Q4 are the series regulators and Q104 and Q105 are the corresponding amplifiers. Regulation is dependent, not upon +6 V and -6 V outputs but upon the +30 V and -30 V outputs applied to the amplifiers through R115 and R121 respectively. The fixed-bias reference for each of these amplifiers is provided by the voltage across Zener diodes CR103 and CR104.

The +225 V output is generated by a bridge type rectifier circuit (CR1 through CR4) having a low power type 2N375 series regulator transistor, Q1, which is controlled by a single-stage-amplifier, Q101. The -30 V regulated output applied to R103 in the divider network is the prime reference for this circuit.

The +43 output is generated by a type 1N716 13-volt Zener diode, CR101, con-

nected across the 30 V and 225 V outputs.

### D. Troubleshooting

Troubleshooting the power supply is straight-forward if a few basic rules are borne in mind.

1) Check all power supplied for correct voltage.

2) If more than one voltage is incorrect, *troubleshoot and repair the supplies in the following order:*

a) -30 V
b) +30 V
c) -6 V
d) +6 V
e) +225 V
f) +43 V

3) If possible, substitute a known good regulator board to help isolate the problem

4) Check all semiconductors in the bad supply with an ohmmeter. Start with the series regulator. It is not necessary, normally, to remove the components from the circuit to make this check. A bad semiconductor will read a direct short or open.

5) Should steps 1-4 fail to locate the problem, check for proper voltages according to the following chart.

+30 VOLT SUPPLY

| Location | Voltage |
|---|---|
| P101-X | +30 V |
| P102-L | -14.5 V |
| Q102-E | +18.5 V |
| Q102-B | +18.0 V |
| Q102-C | 0.3 V |
| Q103-E | -0.2 V |
| Q103-C | -13.0 V |
| P102-K | -0.2 V |
| P101-N | Gnd. |

-30 VOLT SUPPLY

| Location | Voltage |
|---|---|
| P101-J | -46 V |
| P102-H | -31 V |
| P101-V | -30 V |
| Q106-E | -11.8 V |
| Q106-B | -12.0 V |
| Q106-C | -31.5 V |
| Q107-E | -31.0 V |
| Q107-C | -44 V |

+6 VOLT SUPPLY

| Location | Voltage |
|---|---|
| P102-D | +18.8 V |
| Q104-E | +6.6 V |
| Q104-B | +6.4 V |
| Q104-C | Gnd. |

-6 VOLT SUPPLY

| Location | Voltage |
|---|---|
| P102-F | -19.2 V |
| Q105-E | -6.4 V |
| Q105-B | -5.7 V |
| Q105-C | Gnd. |

+225 VOLT SUPPLY

| Location | Voltage |
|---|---|
| P102-S | +234 V |
| P102-A | -55 V |
| P102-B | -0.56 V |
| Q101-E | -0.56 V |
| Q101-B | -1.3 V |
| Q101-C | -1.4 V |

## 4.10 ANNUNCIATOR AND DECIMAL LAMPS

### A. General Description

Figures 4-39 and 4-40 illustrate the control circuitry for the counter. The overall purpose of this circuitry is to light the appropriate decimal and annunciator lamp depending upon the TIME BASE and FUNCTION selected and to provide the measuring unit and decimal lamp information to logic converter circuits when

the D1 or D2 digital output options are installed.

The major functional circuits of this section are: 1) Measuring units selection; 2) Decimal point selection; 3) MU logic converter; and 4) DP logic converter. The components of the MU and DP logic circuits are mounted on a single wired-in printed-circuit board.

### B. Measuring Unit Selection (Figure 4-41)

The circuits of the MU lamps are routed through the TIME BASE and FUNCTION switches and the associated plug-in unit to ground. The correct MU will be automatically illuminated whenever the appropriate combination of TIME BASE and FUNCTION switches is selected. An asterisk is provided for some combinations, e.g. TEST function and $10^{-7}$ TIME BASE, to give an *invalid* unit indication. The FUNCTION and TIME BASE switches also provide the input logic levels to MU portion of the MU & DP PC board. This assembly converts the MU information to BCD "1-2-4-8" (D1 option) or BCD "1-2-2-4" (D2 option) logic for use by any external printer.

### C. Decimal Point Selection (Figure 4-42)

The circuits of the decimal lamps are routed through the TIME BASE and FUNCTION switches and the associated plug-in unit to ground. The correct DP will be automatically illuminated whenever the appropriate combination of TIME BASE and FUNCTION is selected. The returns for decimal lamps I9 through I12 are also provided at the plug-in connector for remote control purposes. Decimal lamp information is also provided to the DP portion of the MU & DP PC board. This assembly converts the DP information to BCD "1-2-4-8" (D1 option) or BCD "1-2-2-4" (D2 option) logic for use by an external printer.

### D. Troubleshooting

Troubleshooting of the selection circuits consists of first checking continuity through the switches for the particular indicator lamp involved, then checking the supply voltage circuit to the lamps, and finally replacement of the lamps themselves.

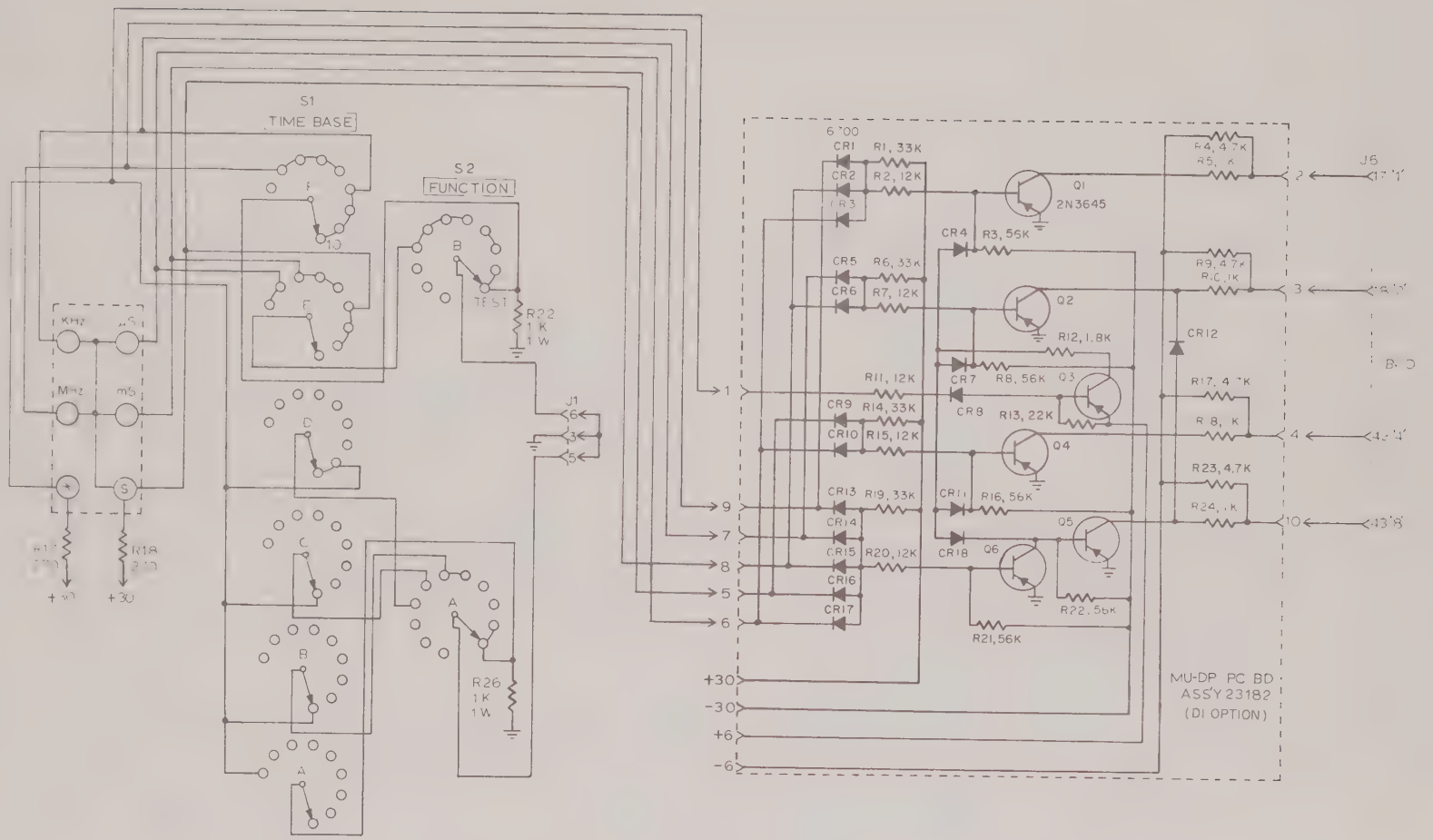



FIGURE 4-39 Annunciator Control (1037/1038)

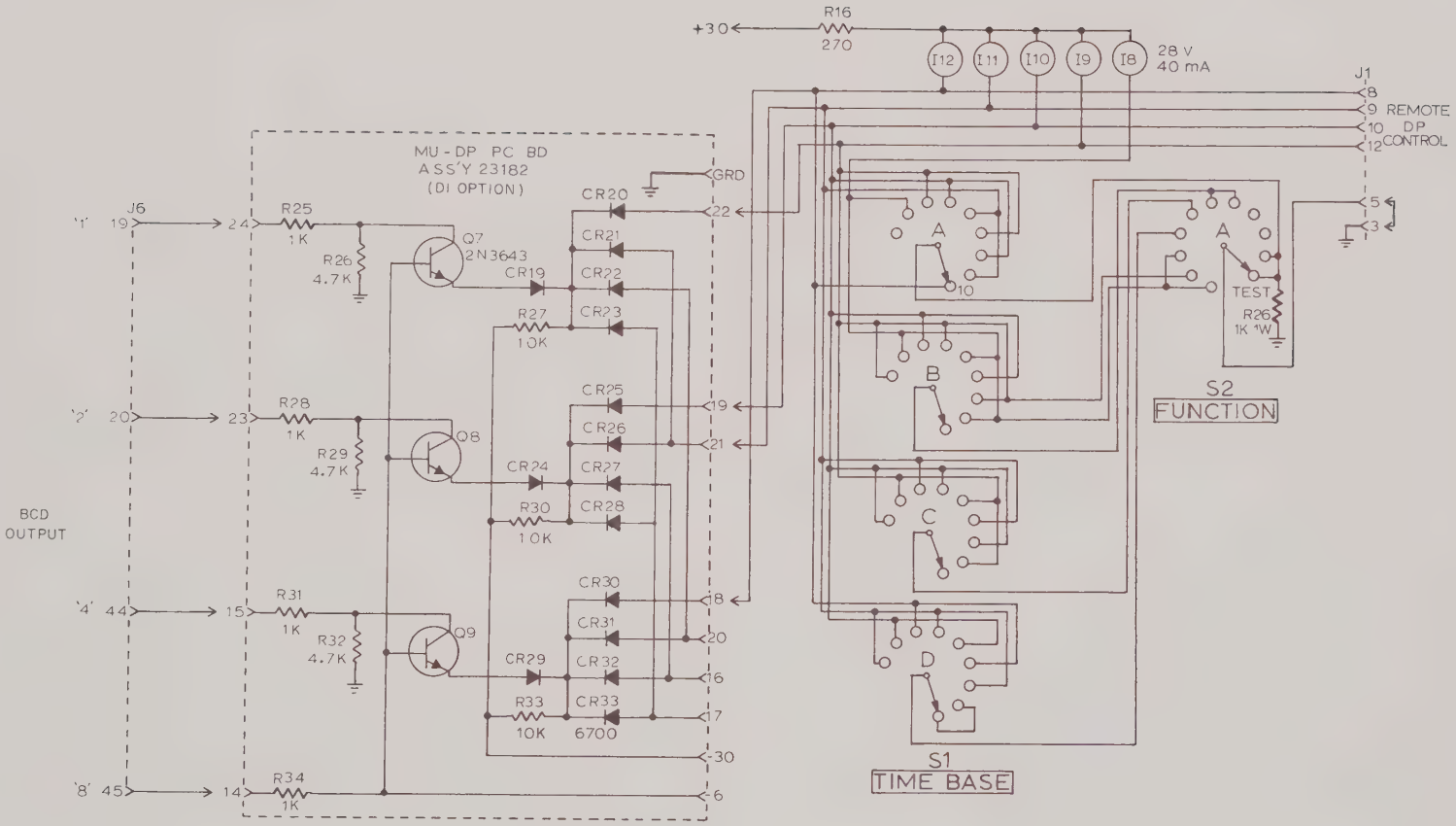
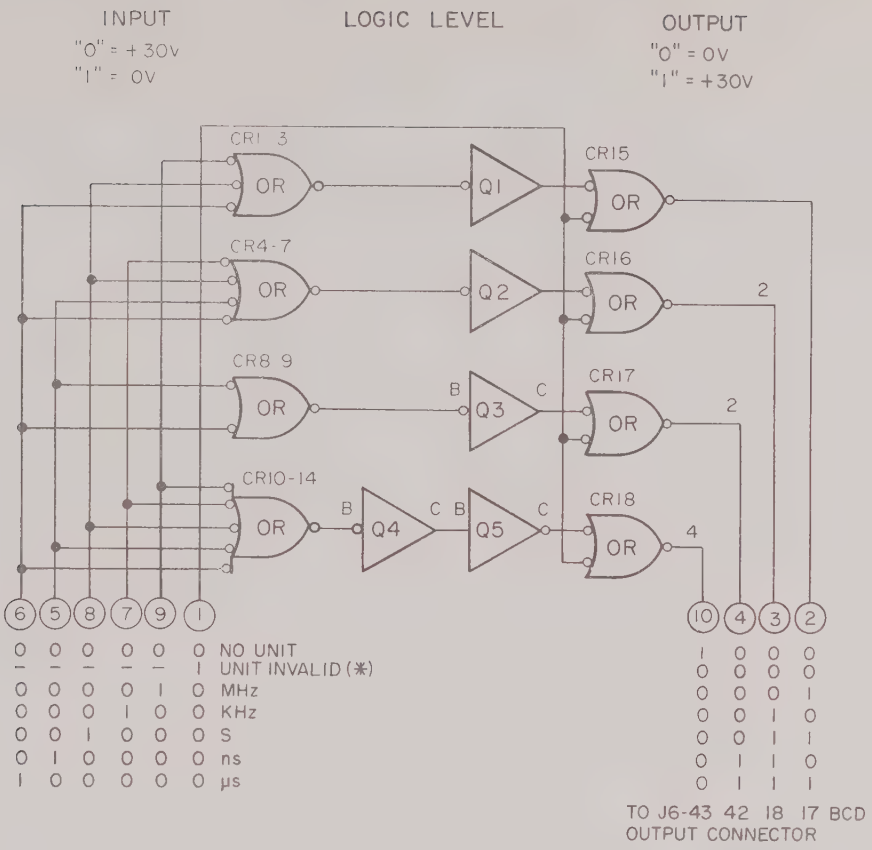



**FIGURE 4-40** Decimal Lamp Control (1037/1038)



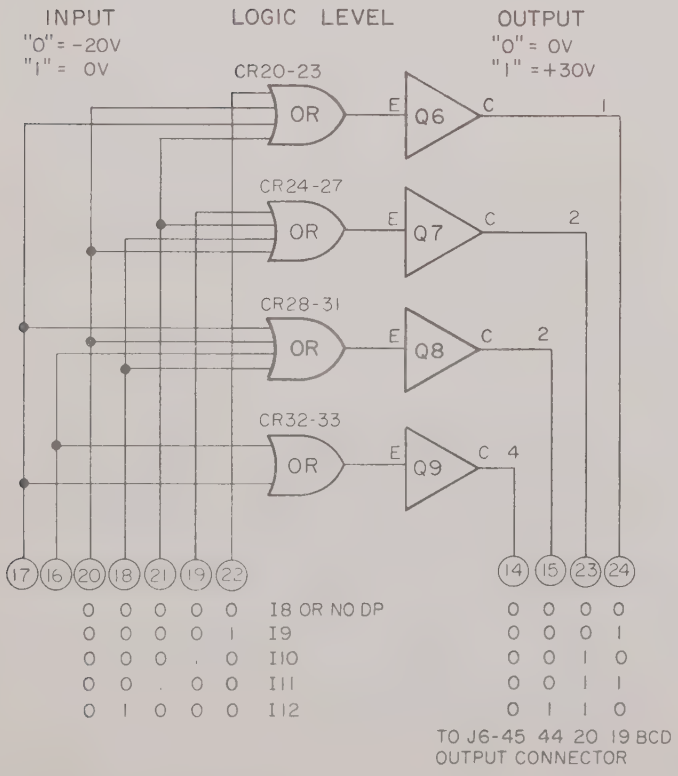




FIGURE 4-41

Detailed Block Diagram

MU & DP Option

"D2"

## 5.1 FACTORY SERVICE

Whenever a Systron-Donner instrument requires service, the nearest SD representative should be contacted. He can provide field service or arrange factory returns when necessary. Address all inquires on operation or application to your nearest sale representative, or Sales Manager, Systron-Donner Corp., 888 Galindo Street, Concord, California 94520. Specify both model and complete serial number in all correspondence.

## 5.2 PREVENTIVE MAINTENANCE

No special preventive maintenance procedures are required. A visual inspection of the interior of the instrument should be made each time it is serviced. Check that all plug-in printed-circuit boards and readout lamps are firmly seated in their sockets and inspect for burned or bulging components.

## 5.3 PRINTED-CIRCUIT BOARD REPAIR

To replace a part on a printed-circuit board, cut the leads of the part near the lead holes. Using a low-power (50-watt or less) soldering iron, apply heat sparingly to the cut lead. As soon as the solder melts, slip the lead from the hole and clean the hole with a toothpick. Clean the board surfaces with isopropyl alcohol. Form the tinned leads of the replacement part and insert in the cleaned holes, trimming leads to extend 1/16-inch beyond the back surface of the board. Use only 63-37 solder with a maximum diameter of 1/16-inch. Solder the leads to the board and use a hemostat, long-nose pliers of other type of heat sink on the leads of all semiconductor devices and 1/4 watt resistors. Allow the soldered junction to cool before removing the heat sink.

## 5.4 PARTS LOCATION

Printed-circuit board outline drawings and schematic diagrams are shown in Figures 5-7 through 5-50.

## 5.5 CALIBRATION

### A. List of Test Equipment

The following list is recommended. Equivalent instruments are acceptable.

1) Oscilloscope - Tektronix Model 581.
2) Plug-in Unit - Tektronix Type 82.
3) One megacycle frequency standard; one part in $10^{10}$ short term.
4) Signal Generator - General Radio Model 1330-A.
5) Function Generator - Hewlett Packard Model 202A.
6) Signal Generator - Hewlett Packard Model 608C.
7) Variable Autotransformer - Superior UCIM.
8) Digital Voltmeter - Systron-Donner Model 9000.
9) Square Wave Generator - H.P. 211A.
10) 60 Hz, 117 V rms source (Item 7 may be used if the line voltage does not measure 117 V rms).
11) Systron-Donner Model 1926A.
12) Systron-Donner Blank plug-in, Model 1942.

### B. General Remarks

1) When a piece of test equipment is referred to in the procedure, its paragraph reference number

as listed in Section A will be called out to avoid ambiguity.

2) Tolerances indicated are exclusive of expected commercial equipment tolerances.

C. **Power Supply**

1) Turn fan blade by hand to see that it is free.
2) Insert blank plug-in (12) into parent counter.
3) Plug line cord into 60 Hz, 117 V rms source (10). Turn POWER switch ON.
4) Observe that fan is operating.
5) Measure with Voltmeter (8) on J101 and adjust the following supplies:
   a) At Pins U,V adjust the -30 volt supply for -30 ±1 V.
   b) At Pins W,X adjust the +30 volt supply for +30 ±1 V.
   c) At Pins S,T adjust the +6 volt supply for +6 ±0.3 V.
   d) At Pins P,R adjust the -6 volt supply for -6 ±0.3 V.
   e) At Pin Z adjust the +225 volt supply for +225 V ±10 V.
   f) Measure Pin Y. Reading should be +42 V ±1 V.
   g) Measure Pin L. Reading should be -24 V ±1 V.
   h) Measure Pin D. Reading should be +26 V ±1 V.
6) Measure with Oscilloscope (1) the following pins of J101. Set time switch to 10 ms/cm. Trigger slope to line. Measure peak-to-peak ripple.
   a) Pin Z 400 mV p-p (+225V Line)
   b) Pin W,X 200 mV p-p (+30V Line)
   c) Pin S,T 100 mV p-p (+6V Line)
   d) Pin R,P 100 mV p-p (-6V Line)
   e) Pin U,V 200 mV p-p (-30V Line)
7) Plug line cord into Variable Autotransformer (7). Connect (7) to (10). Adjust (7) for 100 V rms and measure with (8) the following pins of J101.
   a) Pin U,V -30 ±1 V.
   b) Pin W,X +30 ±1 V.
   c) Pin S,T +6 ±0.3 V.
   d) Pin P,R -6 ±0.3 V.
   e) Pin Z ±225 ±10 V.
8) Repeat Step 6 at 130 V rms.
9) Disconnect instrument from (7) and connect to (10) for balance of tests.

D. **Oscillator and Multiplier**

1) Monitor the output at the "1 MC" jack at the rear panel with the oscilloscope.
2) Place the INTERNAL-EXTERNAL switch to INTERNAL. Adjust R801 on Oscillator board for a 2.8V p-p sinewave.
3) Observe base of Q305. Adjust L801 for maximum amplitude.
4) Observe base of Q807. Adjust L802 for maximum amplitude.
5) Observe P800 pin 1. Adjust L803 for maximum amplitude.
6) Repeat steps 2 to 4.

E. **Time Base**

1) Connect oscilloscope to the "Time Base Out" jack. Rotate the TIME BASE switch through its range and

note that the period on the oscilloscope corresponds to the period selected. The output should be 3.0 V p-p minimum in all positions.

2) Place the INTERNAL-EXTERNAL switch in the EXTERNAL position. Apply a 1.0 V rms 1 MHz signal to the 1 MC jack on the rear panel. Repeat step 1.

3) Change the input signal to 2.0 MHz. Set the TIME BASE switch to 10 sec., the FUNCTION switch to "RATE C", and the DISPLAY control to "∞". Depress the RESET button and note that the GATE light remains on for 5 seconds.

4) Change the input signal to 10 kHz. Change the TIME BASE switch to $10^{-1}$ sec. Depress the RESET button and note that the GATE light remains on for 10 seconds.

5) Disconnect the 10 kHz signal and return the INTERNAL-EXTERNAL switch to INTERNAL. Observe a 2.8 V p-p, 1 MHz signal at the 1 MC jack.

## F. Input Attenuator Adjustment

1) Remove primary power from the instrument.

2) Remove the 50 MHz Amp and Decade PC Board and place on extender card.

3) Reconnect the instrument to the power source and place the POWER switch to the ON position.

4) Connect the squarewave generator (9) to the C INPUT.

5) Set the generator frequency to 10 kHz, amplitude to 0.4V.

6) Set the counter's RANGE switch to 1.

7) Attach the scope probe to the base of Q101 and adjust C103 for best squarewave response (minimum overshoot or rounding of edges).

8) Set the RANGE switch to 10, generator amplitude to 4.0V and adjust C101 for the best squarewave response.

9) Set the RANGE switch to 100, generator amplitude to 10V and adjust C102 for the best squarewave response.

## G. Function Switch

1) Set the FUNCTION switch to COUNT. Connect the TIME BASE output to the C INPUT. Set the TIME BASE selector to 1 sec. and observe that the first indicator (far right) cycles sequentially from 0 to 9.

   a) Change the TIME BASE selector to $10^{-1}$ sec. Observe the second indicator to confirm the proper sequence 0 through 9. Repeat the test for the remaining DCU's using a time base frequency higher than the previous frequency.

2) Disconnect the Time Base output. Rotate the TRIGGER control to minus. Press the RESET button. With no input connected, rotate the TRIGGER control to the plug extreme. One count should be registered on the indicators. Rotate the TRIGGER control again towards the opposite extreme. No count should register as the control passes through zero.

a) Connect generator (5) to the C INPUT. Set the amplitude to 100 mV rms. Place the AC-DC switch to the AC position. Record lowest correct counting rate (must be less than 10 Hz). Change frequency to 1 Hz. Change AC-DC switch to DC. Correct counting should be observed.

3) Place the FUNCTION switch in the TEST position. Set the DISPLAY control for ease of reading. Observe that the indication of the instrument in the various TIME BASE switch positions corresponds to the following table:

| Time Base | Correct Indication |
|---|---|
| $10^{-6}$ | 00000010. MHz |
| $10^{-5}$ | 0000010.0 MHz |
| $10^{-4}$ | 000010.00 MHz |
| $10^{-3}$ | 00010.000 MHz |
| $10^{-2}$ | 0010000.0 kHz |
| $10^{-1}$ | 010000.00 kHz |
| 1 | 10000.000 kHz |
| 10 | (1) 0000.0000 kHz |

±1 count tolerance in right hand column.

| | Time Base Switch | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 1 | | $10^{-1}$ | | $10^{-2}$ | | $10^{-3}$ | | $10^{-4}$ | | $10^{-5}$ | | $10^{-6}$ | | $10^{-7}$ | |
| FUNCTION SWITCH | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp | Indicator | Decimal Lamp |
| TEST | kHz | I12 | kHz | I11 | kHz | I10 | kHz | I9 | MHz | I11 | MHz | I10 | MHz | I9 | MHz | I8 | * | |
| RATE | kHz | I12 | kHz | I11 | kHz | I10 | kHz | I9 | MHz | I11 | MHz | I10 | MHz | I9 | MHz | I8 | * | |
| COUNT | | | | | | | | | | | | | | | | | | |
| HOLD | | | | | | | | | | | | | | | | | | |
| TIME B-A | * | | S | I8 | S | I8 | S | I10 | ms | I8 | ms | I9 | ms | I10 | µs | I8 | µs | I9 |
| PERIOD A | * | | S | I8 | S | I9 | S | I10 | ms | I8 | ms | I9 | ms | I10 | µs | I8 | µs | I9 |
| PERIOD A x 10 | * | | S | I9 | S | I10 | S | I11 | ms | I9 | ms | I10 | ms | I11 | µs | I9 | µs | I10 |
| PERIOD A x 100 | * | | * | | S | I11 | S | I12 | ms | I10 | ms | I11 | ms | I12 | µs | I10 | µs | I11 |
| RATIO C/A | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 |
| RATIO C/A x 10 | | I9 | | I9 | | I9 | | I9 | | I9 | | I9 | | I9 | | I9 | | I9 |
| GATE C/(B-A) | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 | | I8 |

TABLE 5-1

DECIMAL LAMP AND INDICATOR FUNCTION

a) Observe the decimal lights for correct indication per Table 5-1.

b) Observe that the GATE lamp indicates during the counting interval for all settings of the TIME BASE switch except $10^{-7}$ and is extinguished during the display interval.

4) Put the FUNCTION switch in the RATE C position. Connect the signal generator (6) to the C INPUT. Settle frequency to 55 MHz, input amplitude to 90 mV rms. Set the TIME BASE switch to 1 second. Adjust the trigger LEVEL for a stable indication of 55000.000 kHz. Due to instability of the sinewave generator, the two digits on the extreme right may vary from one indication to the next.

a) Note the maximum counting rate up to 65 MHz at 100 mV rms.

b) Note the minimum input amplitude to correctly count to 50 MHz.

**FIGURE 5-1**

**Decimal Light and Indicator Locations**

5) Connect the signal generator (4) to the C INPUT. Set frequency to 1 MHz, amplitude 100 mV rms. Observe correct counting. Change RANGE switch to 10. Record minimum amplitude for correct counting. Change frequency and amplitude to the following and note correct counting. Change RANGE switch to 1

| Amplitude | Frequency |
|---|---|
| 100 mV rms | .00 kHz |
| | 5 MHz |
| | 10 MHz |
| | 25 MHz |
| | 40 MHz |
| 1.0 V rms | 100 kHz |
| | 5 MHz |
| | 10 MHz |
| | 25 MHz |
| | 40 |

6) Change FUNCTION switch to Per. A. Connect generator (9) to C INPUT. Set frequency to 100 Hz, amplitude 0.3 V p-p. Set the TIME BASE switch to $10^{-6}$ sec. and adjust the trigger LEVEL for a stable count. The indication should be 00010000. µs.

a) Change TIME BASE switch to 10 $10^{-7}$ sec. The indication should be 0010000.0 µs.

b) Change FUNCTION switch to PER A x 10. The indication should be 010000.00 µs.

c) Change FUNCTION switch to PER A x 100. Indication should be 10000.000 µs.

d) Plug in the Model 1926A (11). Connect the generator to the A input. Set the SLOPE switches to +. Adjust the A input trigger LEVEL control. The indication should be 10000.000 µs.

7) Change FUNCTION switch to TIME B-A. Same input as Step 6. Set both SLOPE switches to "+", and the SEP-COM switch to COM. Adjust the B trigger control for a stable count indication of 0010000.0 μs using the $10^{-7}$ sec. time base.

a) Change both SLOPE switches "-". The indicators should read the same.

b) Change the B SLOPE switch to "+" and note the reading.

c) Change both SLOPE switches to the opposite polarities and again note the reading. The sum of the readings in Steps b and c should equal the reading of Step 7. Return both switches to "+".

8) Change FUNCTION switch to SEP $\frac{C}{B-A}$. Same input as SEP-COM switch to SEP. Apply a 1 Hz signal at 0.3 V p-p to C INPUT from generator (4). The indication should be 00010000.

9) Change FUNCTION switchto RATIO C/A, change the COM-SEP switch to SEP. Apply a 1 Hz, 0.3 V p-p signal to the C INPUT and a 100 Hz signal, 0.3 V p-p to the A INPUT. The indication should be 00010000.

a) Change the FUNCTION switch to C/A x 10 and note that the reading is ten times larger than before.

## H. Display Interval

(1) Place the FUNCTION switch to TEST and the TIME BASE switch to one second. Turn the DISPLAY control to maximum without closing "infinity" switch. Depress the RESET button and then release. The instrument should cycle one time and hold its indication for greater than 5 seconds before it recycles. Close the "infinity" switch and note that the instrument will not cycle. Observe for 30 seconds.

## I. Storage

1) Interrotation Pulse - Storage off Mode.

a) Set the FUNCTION switch to COUNT and the STORAGE switch to ON.

b) Observe the interrogation pulse at the point indicated in Figure 5-2 on each of the 7 decade boards and on the 50 MHz readout board:

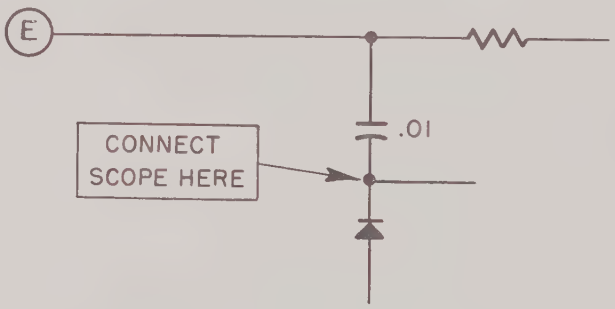



**FIGURE 5-2**

INTERROGATION PULSE MEASURING POINT

c) Check the following (See Figure 5-3).

(1) Base Line = Beteeen -1.0 and 0 volts.

(2) $T_{15V}$ = 35 μs minimum.

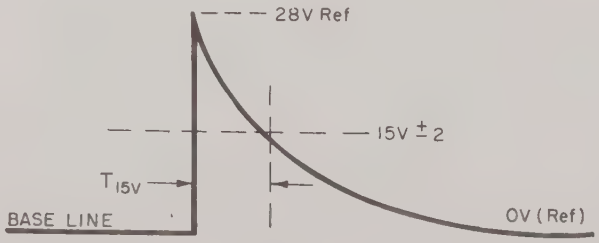



**FIGURE 5-3**

Interrogation Pulse

d) Check the interrogation pulse at the point indicated in Figure 5-2 on any one of the 7 decade boards. See that the period is between 5 and 15 milliseconds.

e) Observe storage reset pulse at Pin E or J101.

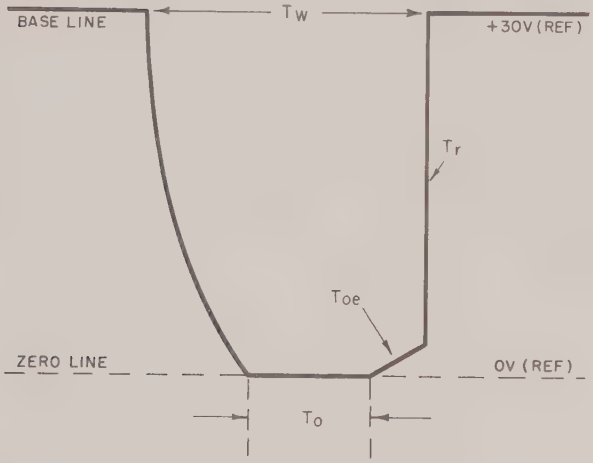



**FIGURE 5-4**
**Storage Reset Pulse**

f) Check the following (see Figure 5-4)

1) Base Line - within 1.0 volt of the +30 V Buse.
2) Zero Line - between -1.0 and 0 volts
3) $T_o$ = 40 µs minimum.
4) $T_w$ = between 100 and 500 µs.
5) $T_r$ (10-90% rise time) = between 2.0 and 5.0 µs.
6) Toe amplitude (if present) = less than 2.0 V.

g) Set the FUNCTION switch to RATE, the DISPLAY control to "∞" and the STORAGE switch to ON.

1) Observe that the waveform on Pin E of J101 (above) has a period of between 5 and 15 milliseconds.

2) Interrogation timing - Storage ON Mode.

a) Set the counter controls as follows:
1) FUNCTION to RATE.
2) STORAGE to ON.
3) DISPLAY fully CW.

b) Connect a generator of suitable amplitude and frequency to the counter. Slowly vary the generator output frequency and check that the readout changes only at end of count (GATE light goes out). Check each digit on each of the eight indicators. The TIME BASE Switch may be set to the most convenient position.

## J. Oscillator Accuracy Check (All Models)

1) General

The frequency accuracy of the oscillator may be determined relative to a frequency standard by observing the rate of drift of the oscilloscope pattern as shown by the test set-up in Figure 5-5.

a) If the pattern moves to the right, the counter oscillator frequency is lower than the standard frequency. If the pattern moves to the left, the oscillator frequency is higher. The reciprocal of the time in seconds for the pattern to move the width of one cycle equals the frequency difference in parts per $10^6$ with a 1 MHz input.

b) If the pattern drifts to the left with a rate equal to the width of one cycle in 10 seconds, the oscillator frequency is 1 part in 10 too high. If the pattern moves the width of one cycle in 100 seconds the error is 1 part in 10 .

c) Movement of the pattern may be accurately checked using an oscilloscope with calibrated sweeps by timing the movement of the point at which the oscilloscope trace corsses the base line when the horizontal sweep is expanded and vertical gain is increased.

2) To check oscillator frequency (not stability):

a) Trigger the oscilloscope externally with the 1 MHz internal Time Base, available at the rear panel of counter.

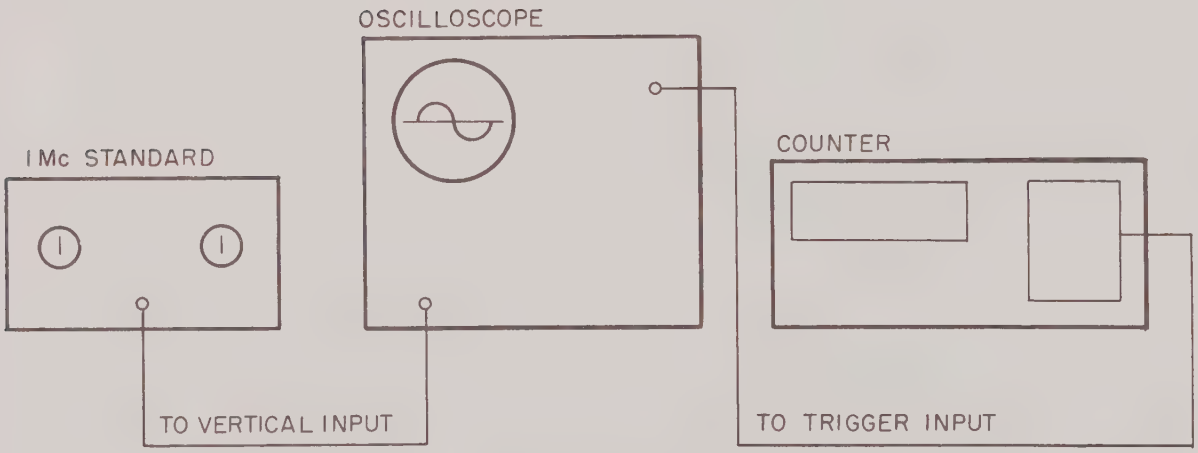



**FIGURE 5-5**
Oscillator Accuracy Test Set-Up

b) Connect a 1 MHz frequency standard to the vertical in- of the oscilloscope.

c) Set the oscilloscope sweep time to .1 μ sec/cm and ad just the controls to obtain a presentation of a 5 V peak-to-peak waveform. Use other time scales with faster scopes.

d) Horizontal drift of the oscilloscope display in cm/sec is the difference between standard frequency in parts per 10 . Adjust the oscillator if necessary to the absolute frequency as given below and in the specifications.

DRIFT vs. FREQUENCY

| Drift of Pattern | |
|---|---|
| 1 cm/sec | 1 part in $10^7$ (0:1 Hz) |
| 1 cm/10 seconds | 1 part in $10^8$ (0:1 Hz) |
| 1 cm/100 seconds | 1 part in $10^9$ (0:00 Hz) |

3) B and B4 Option High-Stability Oscillator Circuits.

a) B Option Power Supply

1) Connect instrument to power source and turn the POWER switch ON. Using the Voltmeter (8), measure the voltage on Pin E1 of the master oscillator assembly and verify that it is between +24 and +28 volts.

b) ÷3 circuit.

1) Connect an oscilloscope to E3 on the master oscillator and observe a d MHz signal.with a minimum amplitude of 0.5V.

2) Connect the scope to the collector of Q802 on the " 3 multiplier" board and observe a 3 MHz square wave with approximately 50% duty cycle and an amplitude of 8 volts ±1 volt.

3) Connect the scope to the emitter of Q806 and observe a 1 MHz squarewave with an amplitude of 8 volts ±1 volt.

4) Adjusting Frequency Using Error Expander.

a) The most convenient way to set the counter oscillator frequency, partularly the high stability oscillator, is by the use of an error expander. Adjustment of the counter oscillator can very quickly be made with a resolution of one part in 10 using this method of adjustment. The error expander required a one megacycle reference which is used as the basis against which the counter oscillator signal is compared. The 1 MHz at the rear panel of the counter is the second input required. The error expander provides an output that has the error expanded by 10, 100 and 1000. When the 10 output is connected to the counter input, it provides a measurement resolution of 1 part in $10^9$ for a one second gate time.

Therefore each count in the counter represents one part in $10^9$ difference between the 1 MHz reference used in the error expander and the 1 MHz signal generated in the counter. Correspondingly for a 10 second gate period the count displayed in the counter represents one part in $10^{10}$

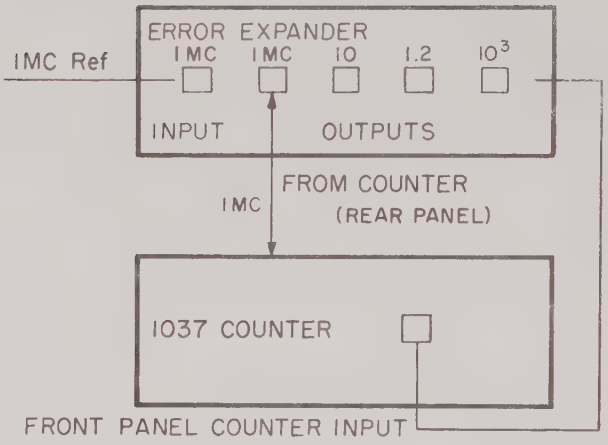
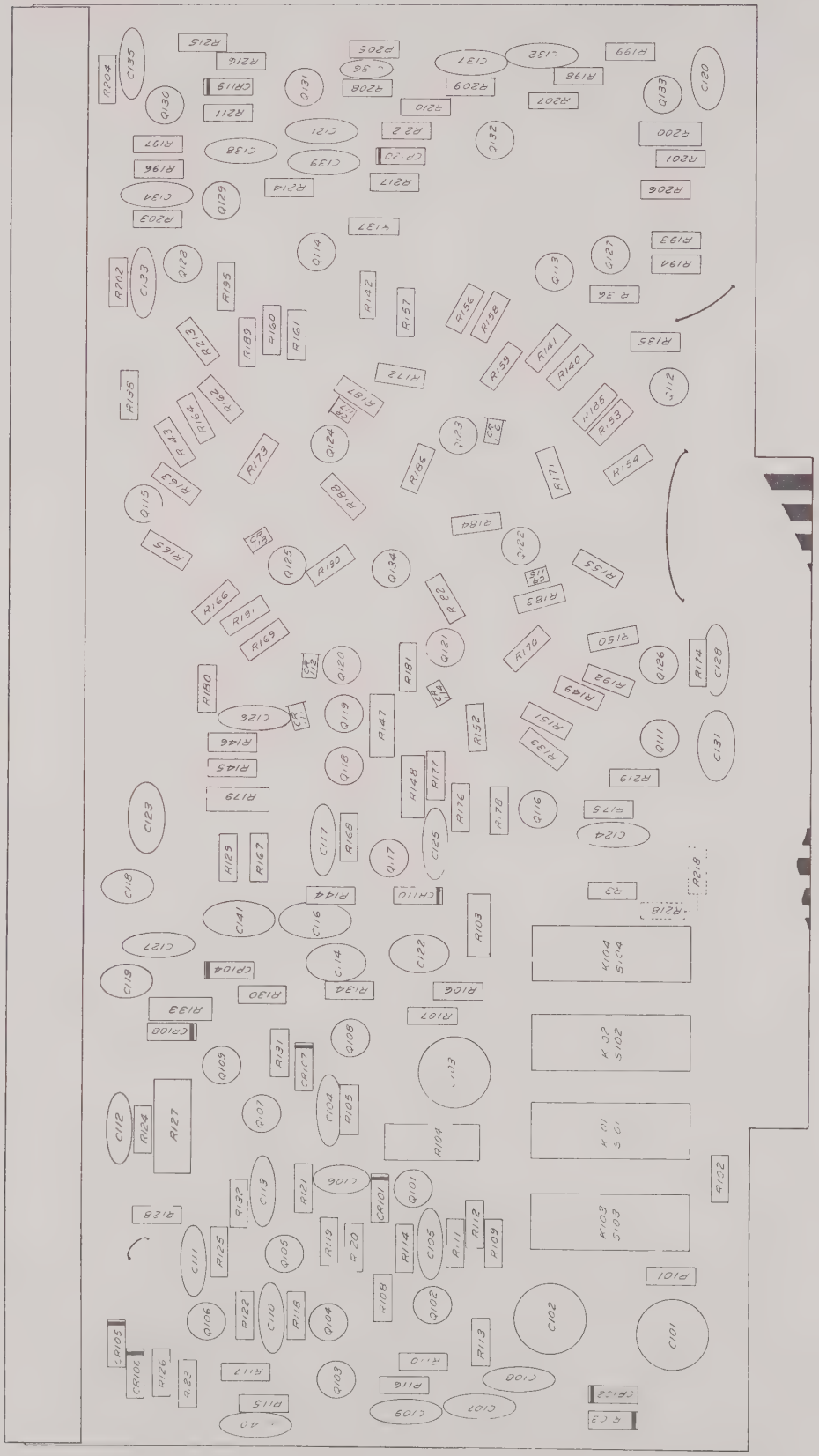


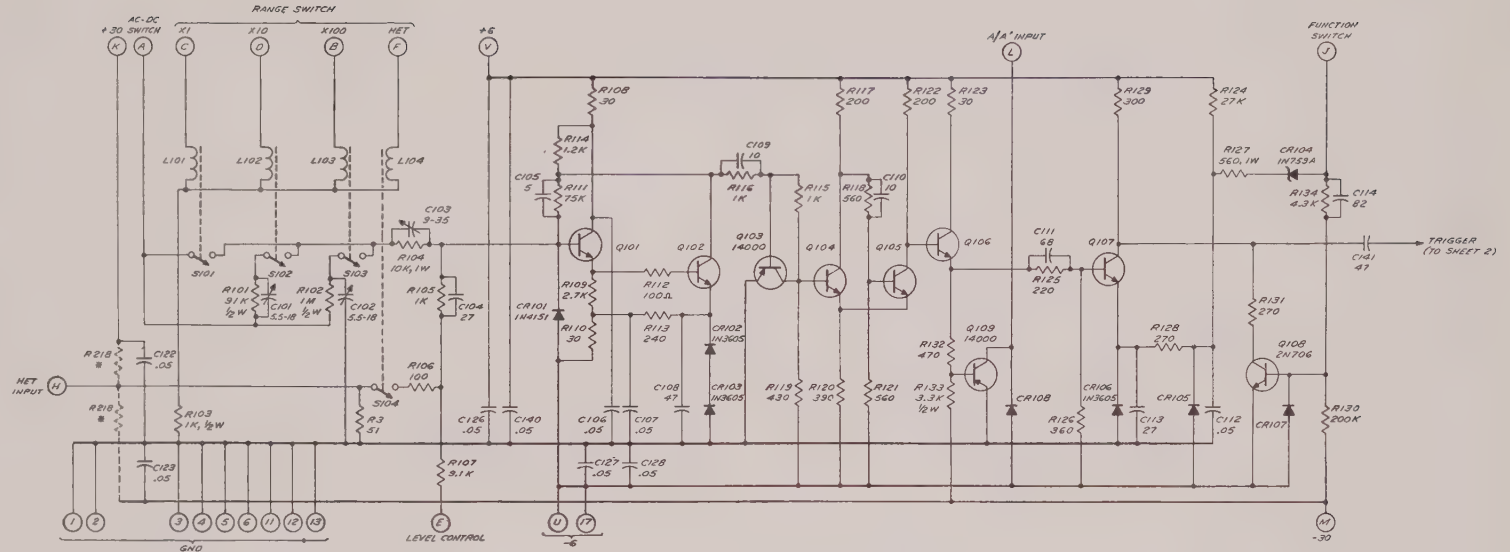

**FIGURE 5-6**

Oscillator Frequency Adjustment Using Error Expander

# CHAPTER 6
# RELATED DRAWINGS and PARTS LIST



ASSEMBLY
50 MHz
AMP & DECADE
13534

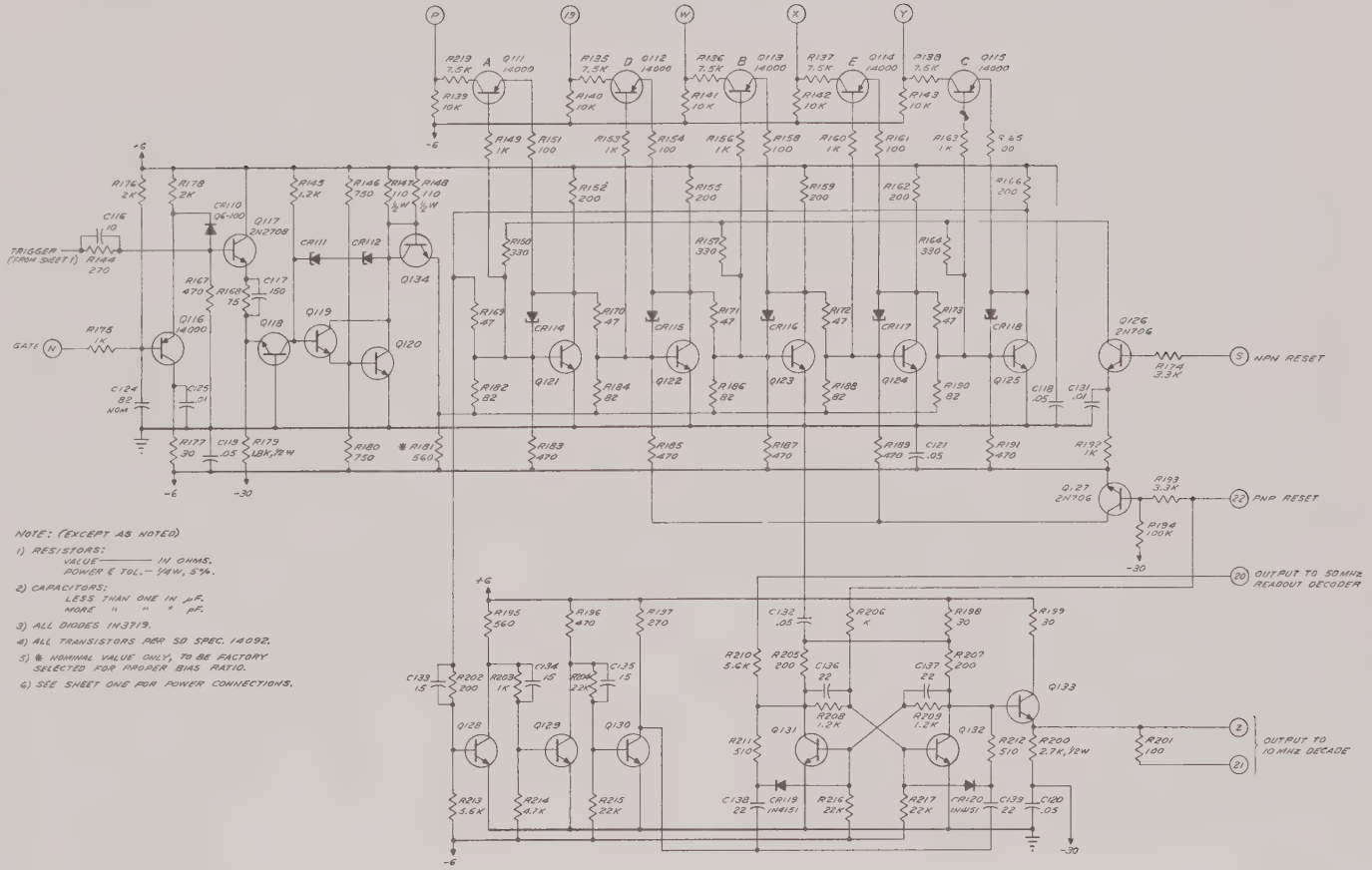


NOTE: (EXCEPT AS NOTED)

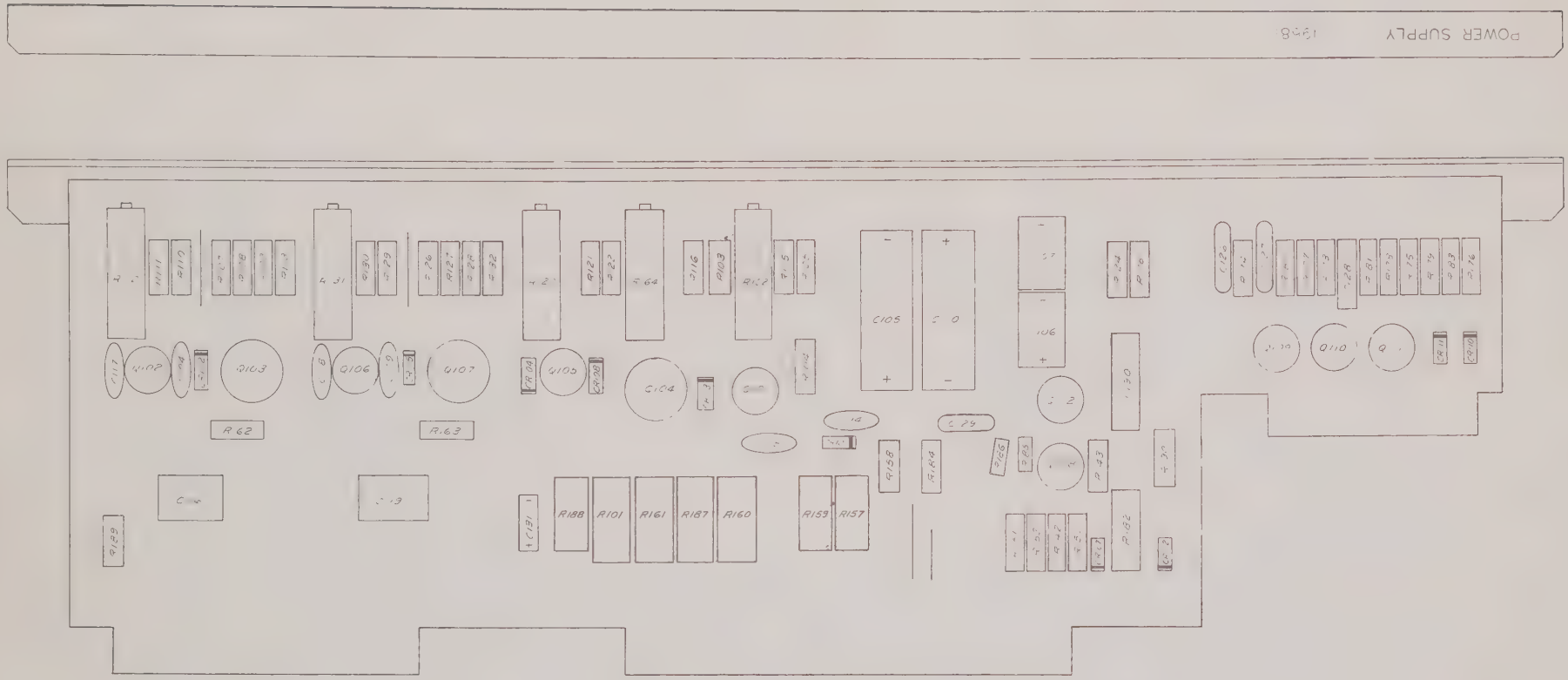
1) RESISTORS: VALUE - IN OHMS.
POWER & TOL.- ¼W, 5%.
2) CAPACITORS: LESS THAN ONE IN μF.
MORE " " " " pF.
3) ALL DIODES PER SD SPEC. 6700.
4) ALL TRANSISTORS PER SD SPEC. 14092.
5) * NOMINAL VALUE 39K, TO BE FACTORY SELECTED FOR PROPER BIAS RATIO. RESISTOR (R818) MAY CONNECT TO +30 OR -30.

SCHEMATIC
50 MHz
AMP & DECADE
13531 Sh. 1

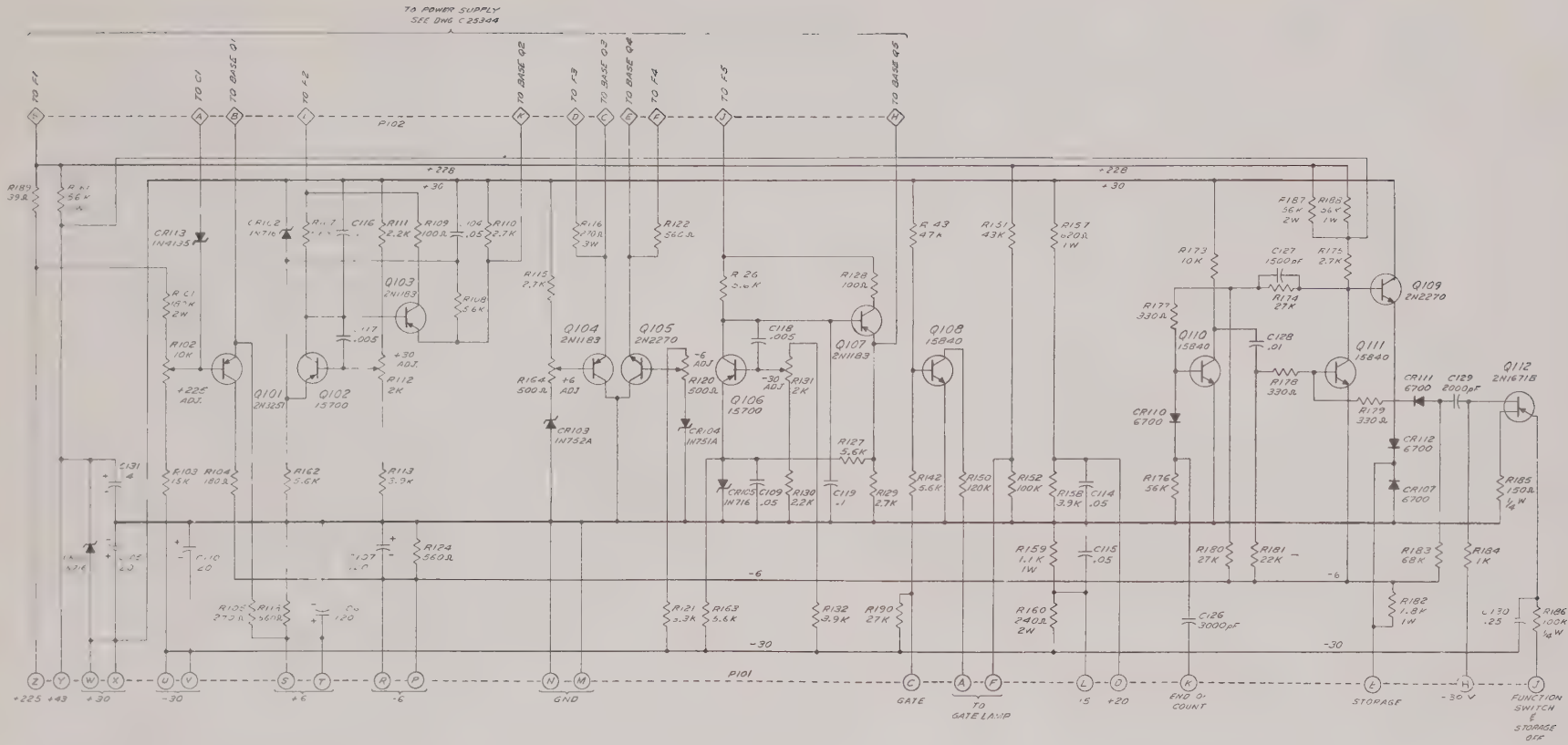
NOTES

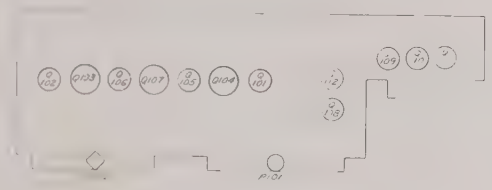

TRIGGER (FROM SHEET 1)
GATE
NPN RESET
PNP RESET
OUTPUT TO 50 MHz READOUT DECODER
OUTPUT TO 10 MHz DECADE
NOTE: (EXCEPT AS NOTED)
1) RESISTORS: VALUE ——— IN OHMS. POWER & TOL. — 1/4W, 5%.
2) CAPACITORS: LESS THAN ONE IN µF. MORE " " " pF.
3) ALL DIODES 1N3719.
4) ALL TRANSISTORS PER SD SPEC. 14092.
5) * NOMINAL VALUE ONLY, TO BE FACTORY SELECTED FOR PROPER BIAS RATIO.
6) SEE SHEET ONE FOR POWER CONNECTIONS.

SCHEMATIC
50 MHz
AMP & DECADE
13531 Sh. 2




ASSEMBLY
POWER SUPPLY
19681



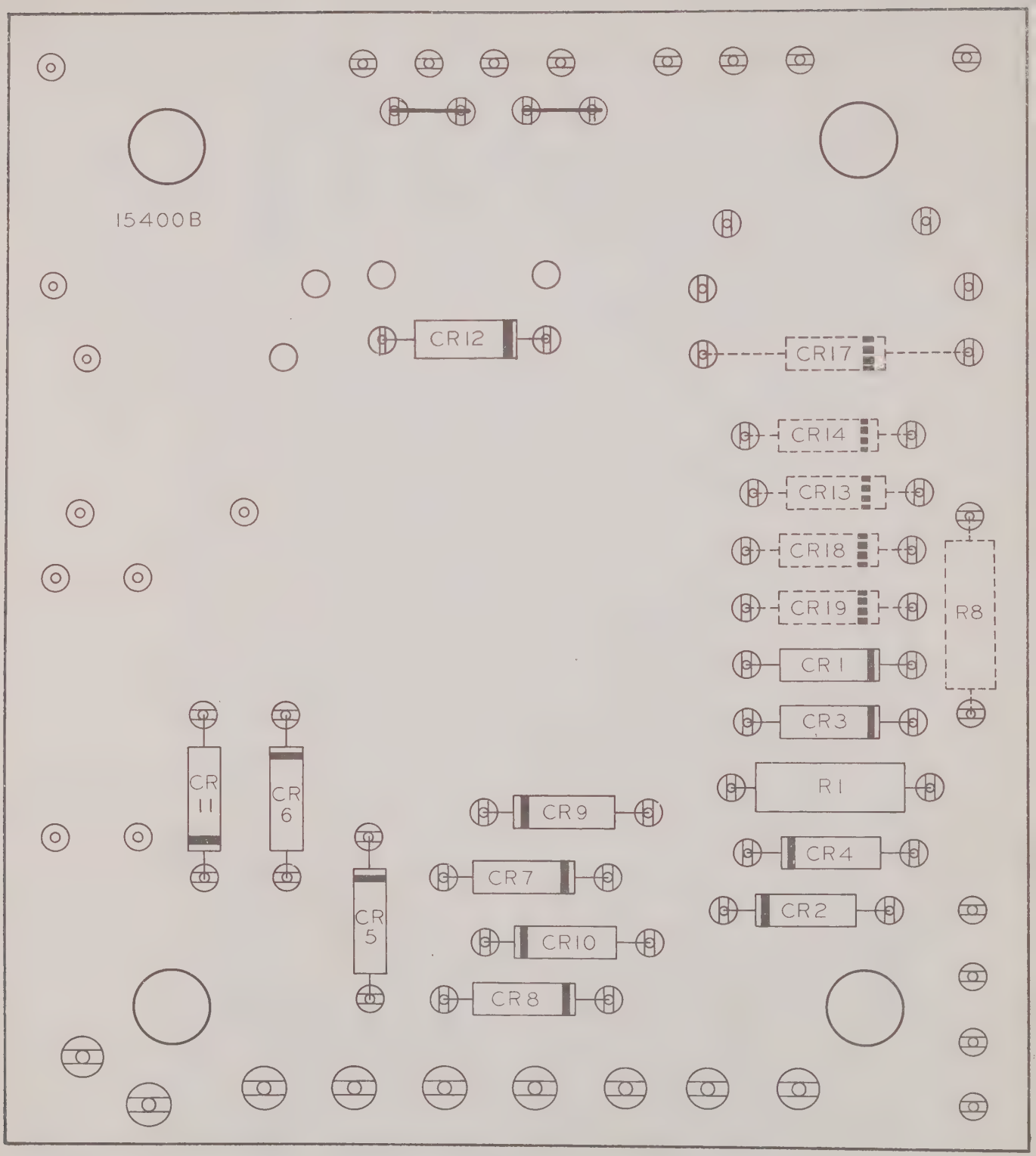



NOTE:
EXCEPT AS NOTED:

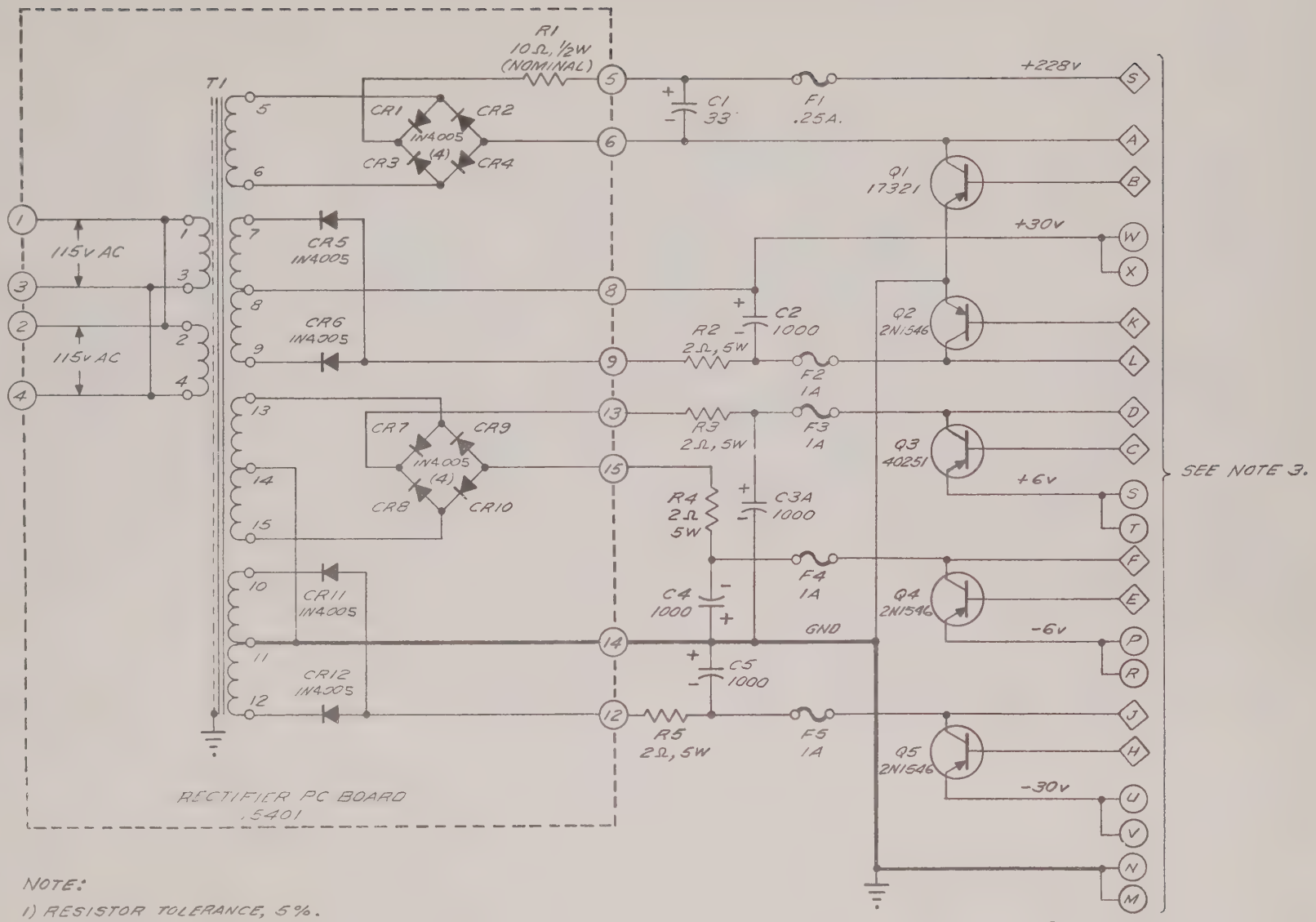
1) RESISTORS:
POWER ---------- 1/2W.
TOLERANCE ------- 5%.

2) CAPACITORS:
VALUE ---------- IN μF.

SCHEMATIC
POWER SUPPLY
P.C. Assembly
23478




ASSEMBLY
POWER SUPPLY
RECTIFIER
15401




NOTE:

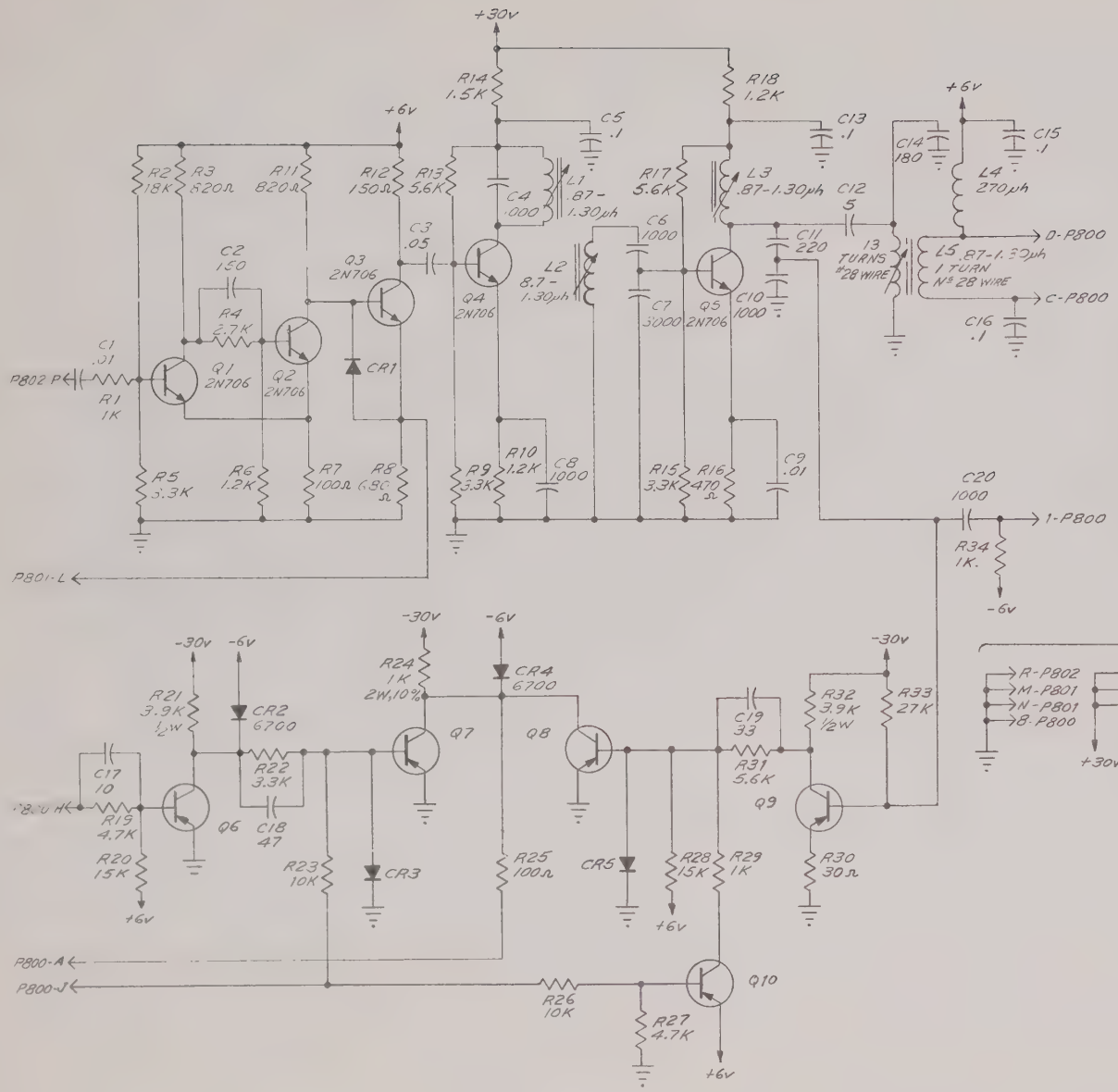
1) RESISTOR TOLERANCE, 5%.
2) CAPACITOR VALUES IN μF.
3) ○ - CONNECTIONS TO REGULATOR PC BOARD, P101.
   ◇ - " " " " " , P102.

SCHEMATIC
Power Supply
25344

MULT 17966 10MC 10MC 5MC 5MC




ASSEMBLY
MULTIPLIER
17966




NOTE: (UNLESS OTHERWISE SPECIFIED)

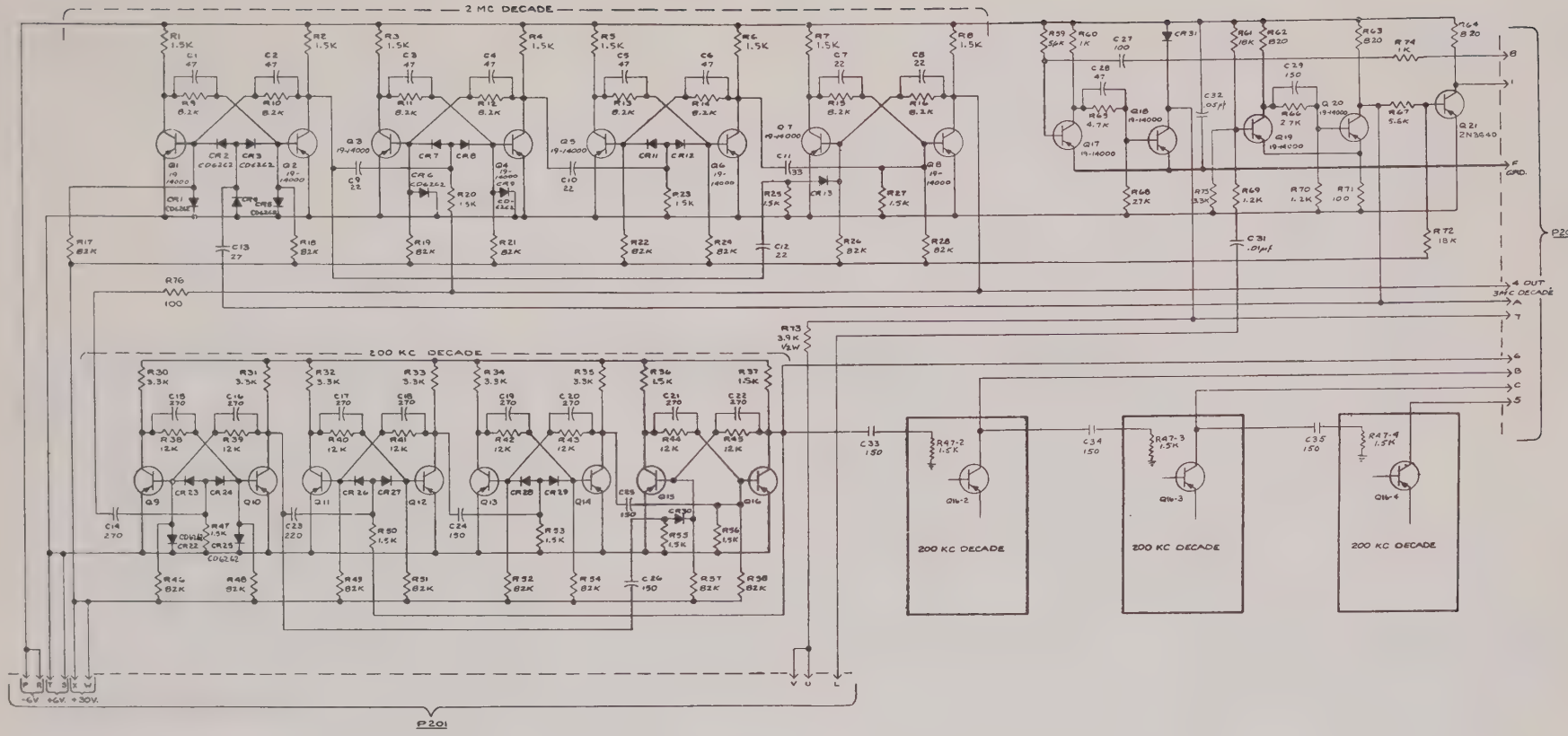
1) TRANSISTORS ARE SD 14000.
2) DIODES ARE CD6262.
3) RESISTORS: 1/4 W, 5%. VALUES IN OHMS.
4) CAPACITORS: ±10%, 50v MIN. VALUE > 1 IN pF. VALUE < 1 IN μF.

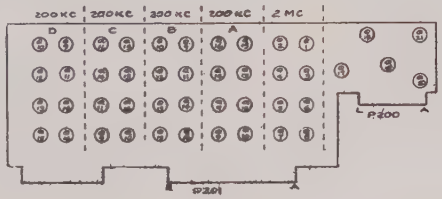
SCHEMATIC
MULTIPLIER
17970

TIME BASE 15422



ASSEMBLY
TIME BASE P.C. ASSEMBLY
15422

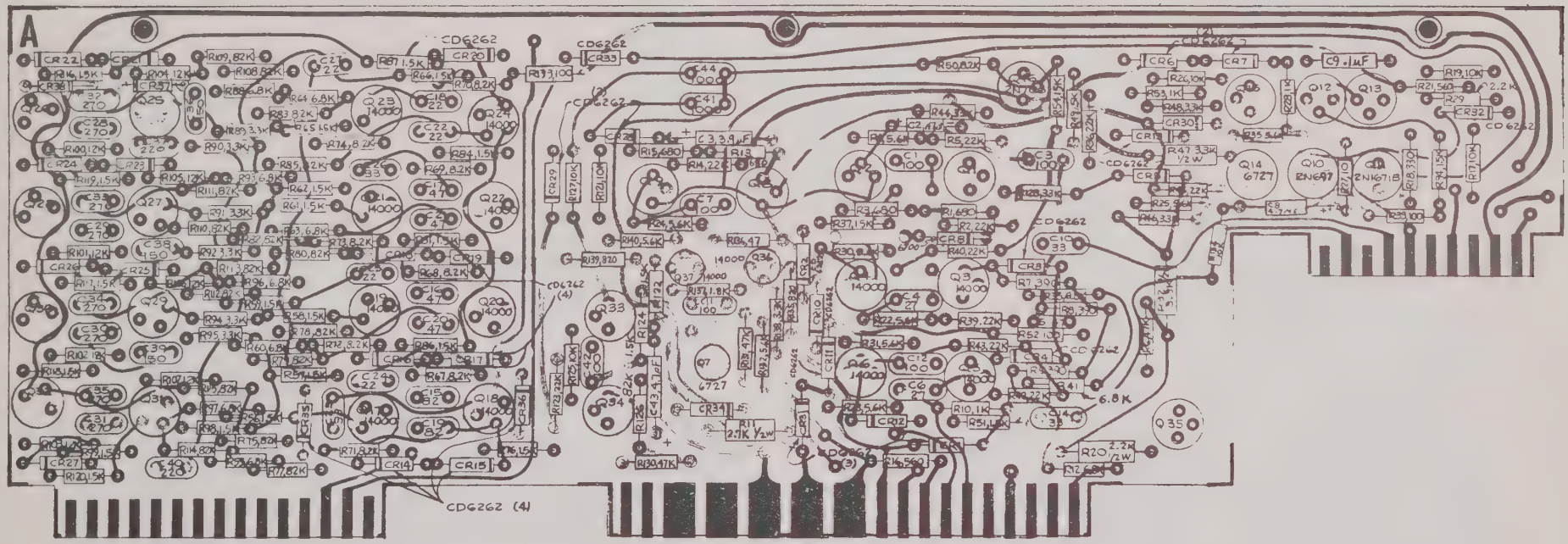


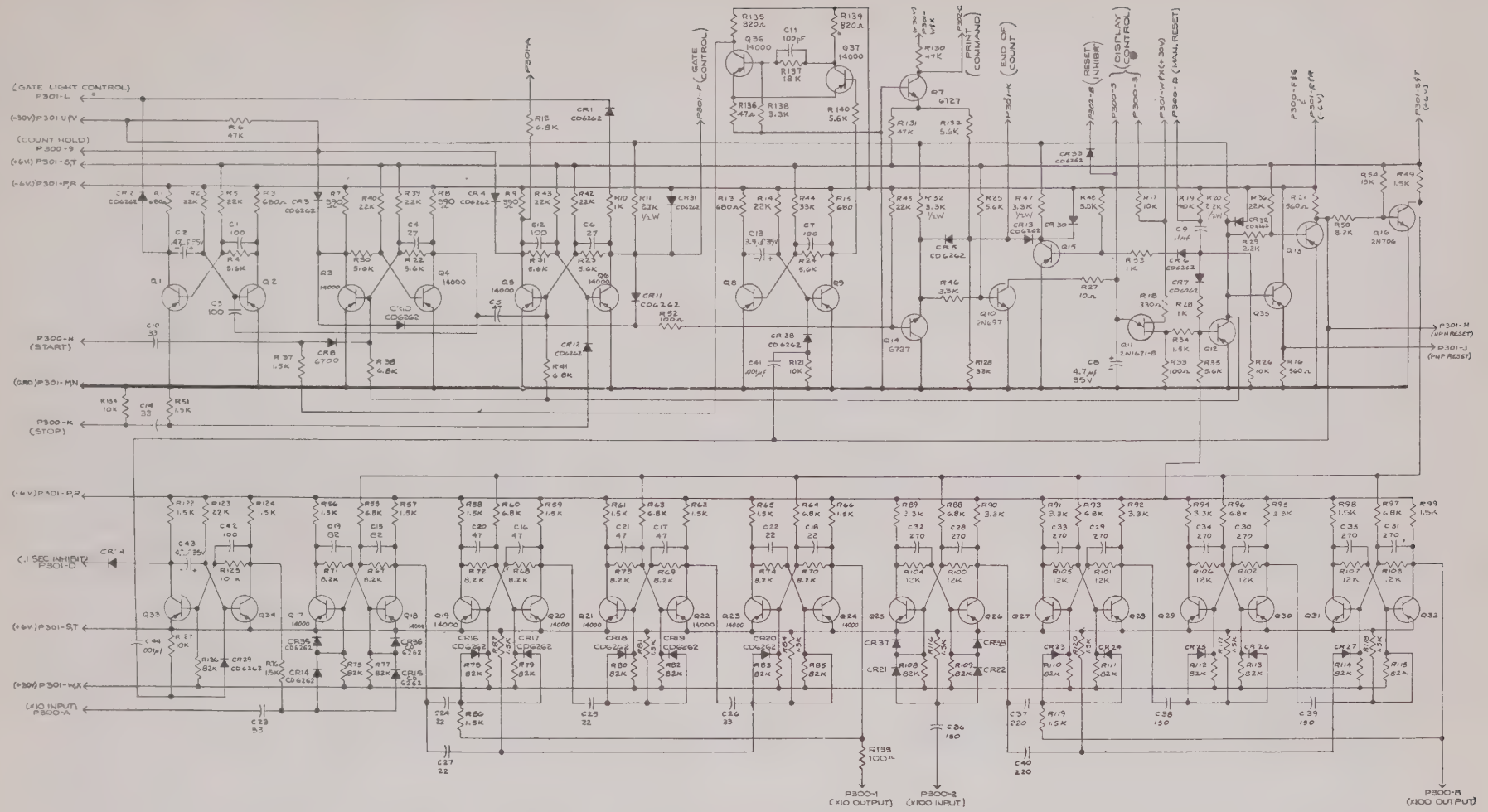




NOTE: UNLESS OTHERWISE SPECIFIED-

1. ALL 200 KC DECADES ARE IDENTICAL.
2. RESISTORS, 1/4 W, 5%; RESISTANCE IN OHMS.
3. CAPACITANCE IN μμf.
4. DIODES, 6700.
5. TRANSISTORS, 19-15700

SCHEMATIC
TIME BASE DIVIDE
(5 Decade)
15423


A
CD6262
CD6262 (4)
CD6262 (3)
CD6262 (2)
CD6262 (1)
CD6262
CD6262
CD6262




6. TRANSISTORS M4000 & 6727 ARE PER SYSTRON-DONNER DWGS 14000 & 6727.
5. ALL TRANSISTORS ARE 15700 PER SYSTRON-DONNER DWG Nº 15700.
4. DIODES PER SYSTRON-DONNER DWG. 6700.
3. CAPACITOR VALUES ARE IN pf.
2. ALL CAPACITORS ARE 50V MIN., ± 10% EXCEPT C 2, 9, 13 & 43 ARE 35V, ±20%.
1. ALL RESISTORS ARE ± 5%, 1/4W, CARBON.
UNLESS OTHERWISE SPECIFIED.

NOTES

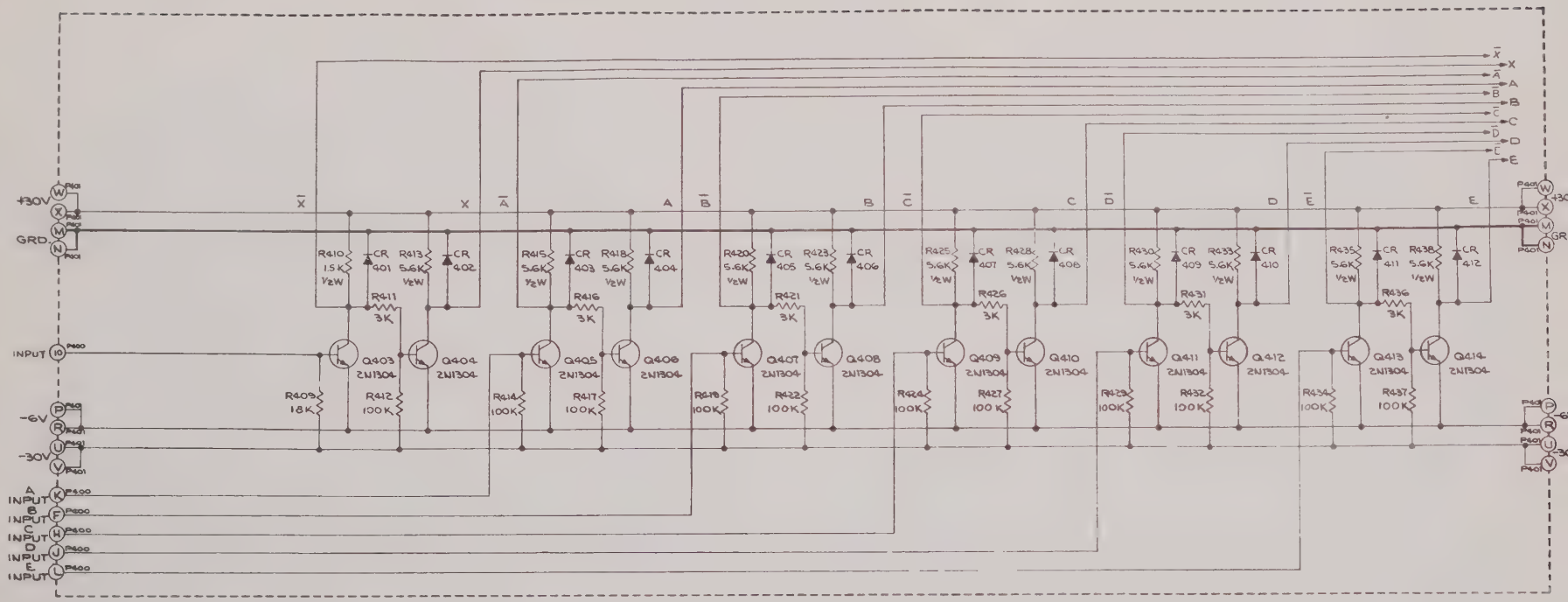
SCHEMATIC
DISPLAY & RESET
19244

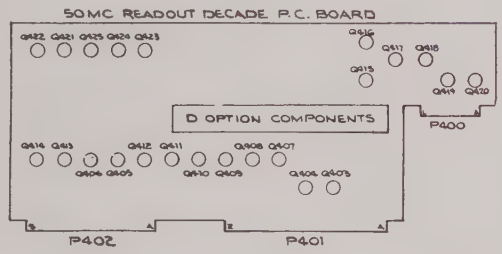
50 MC 12979




ASSEMBLY
50 MHz
READOUT P.C. ASSEMBLY
12979

NOTES

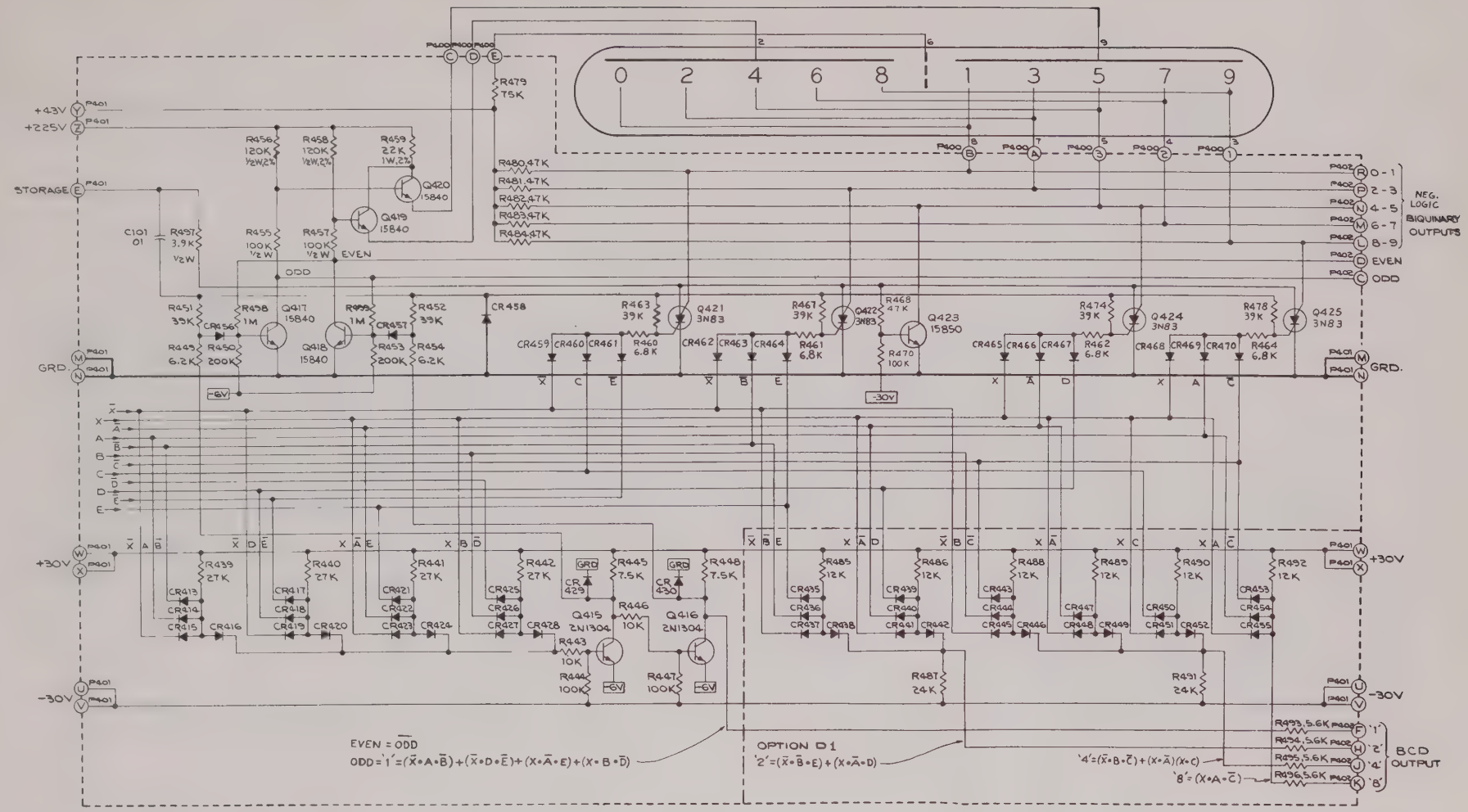



NOTES:
UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ½W, ±5%.
2. ALL DIODES PER SYSTRON-DONNER SPECIFICATION NO. G700.
3. Q417 THRU Q420 PER SYSTRON-DONNER SPECIFICATION NO. 5840.
4. 
5. Q423 PER SYSTRON-DONNER SPECIFICATION NO. 15850. ( STANDARD DECADE )

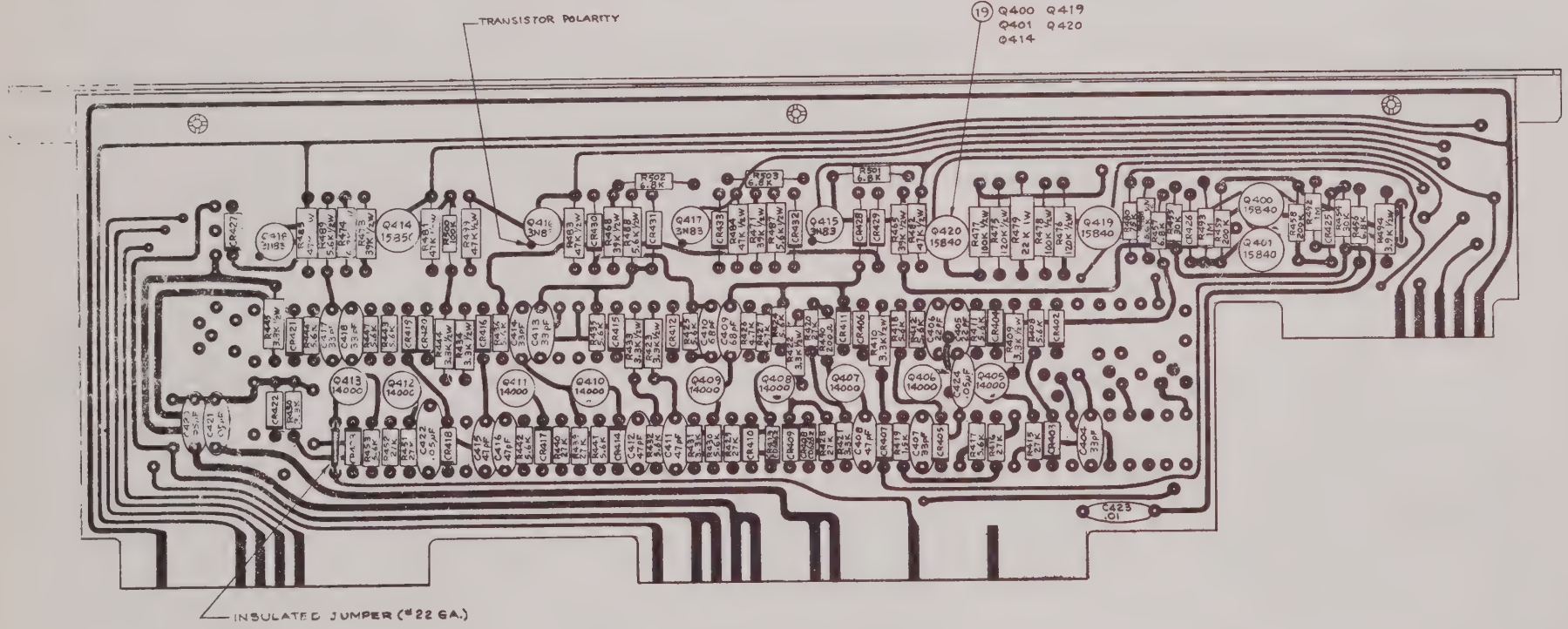
SCHEMATIC
50 MC
STORAGE READOUT Sh. 1
12978




NOTE:
UNLESS OTHERWISE NOTED:
1) LOGIC SYMBOLS REFER TO POSITIVE LOGIC.

SCHEMATIC
50 MC
STORAGE READOUT Sh. 2
12978

10 MC 15200

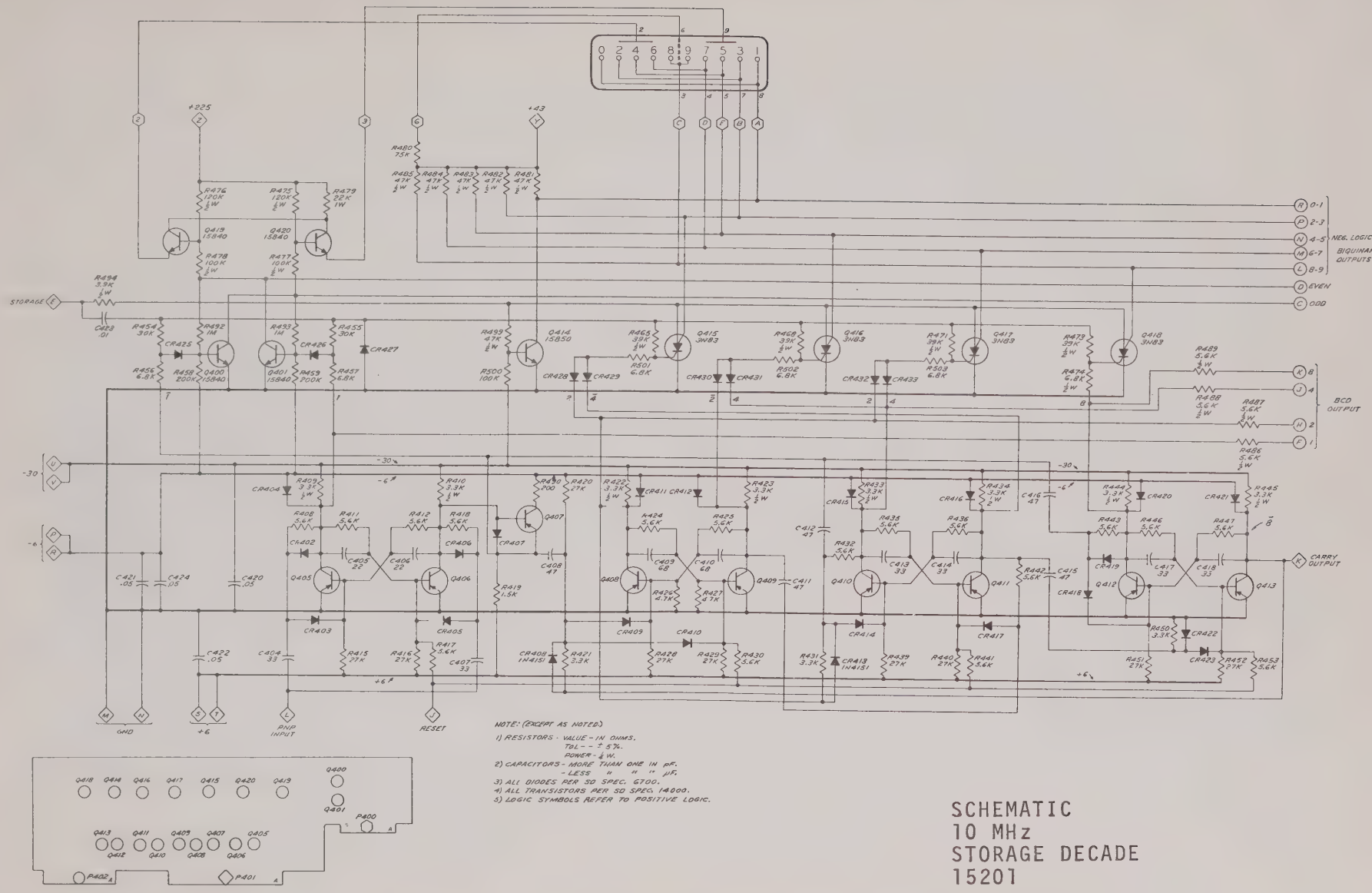



NOTE:
EXCEPT AS NOTED:
1) RESISTORS 1/4W 5%.
2) DIODES ARE 6700.
3) SCHEMATIC: 15201
P/L 15200

ASSEMBLY
10 MHz
DECADE
15200

NOTES

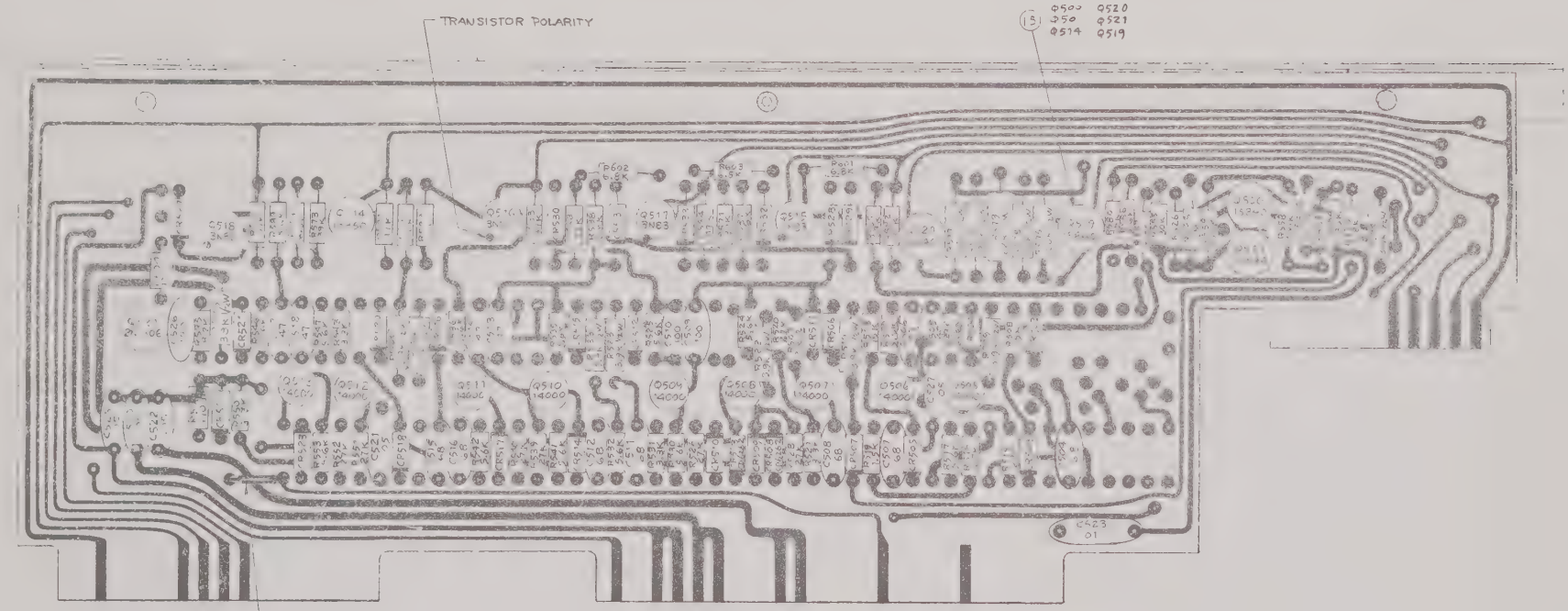
NOTES




NOTE: (EXCEPT AS NOTED)

1) RESISTORS - VALUE - IN OHMS.
   TOL - - ± 5%.
   POWER - ½ W.
2) CAPACITORS - MORE THAN ONE IN pF.
   - LESS " " " µF.
3) ALL DIODES PER SD SPEC. 6700.
4) ALL TRANSISTORS PER SD SPEC. 14000.
5) LOGIC SYMBOLS REFER TO POSITIVE LOGIC.

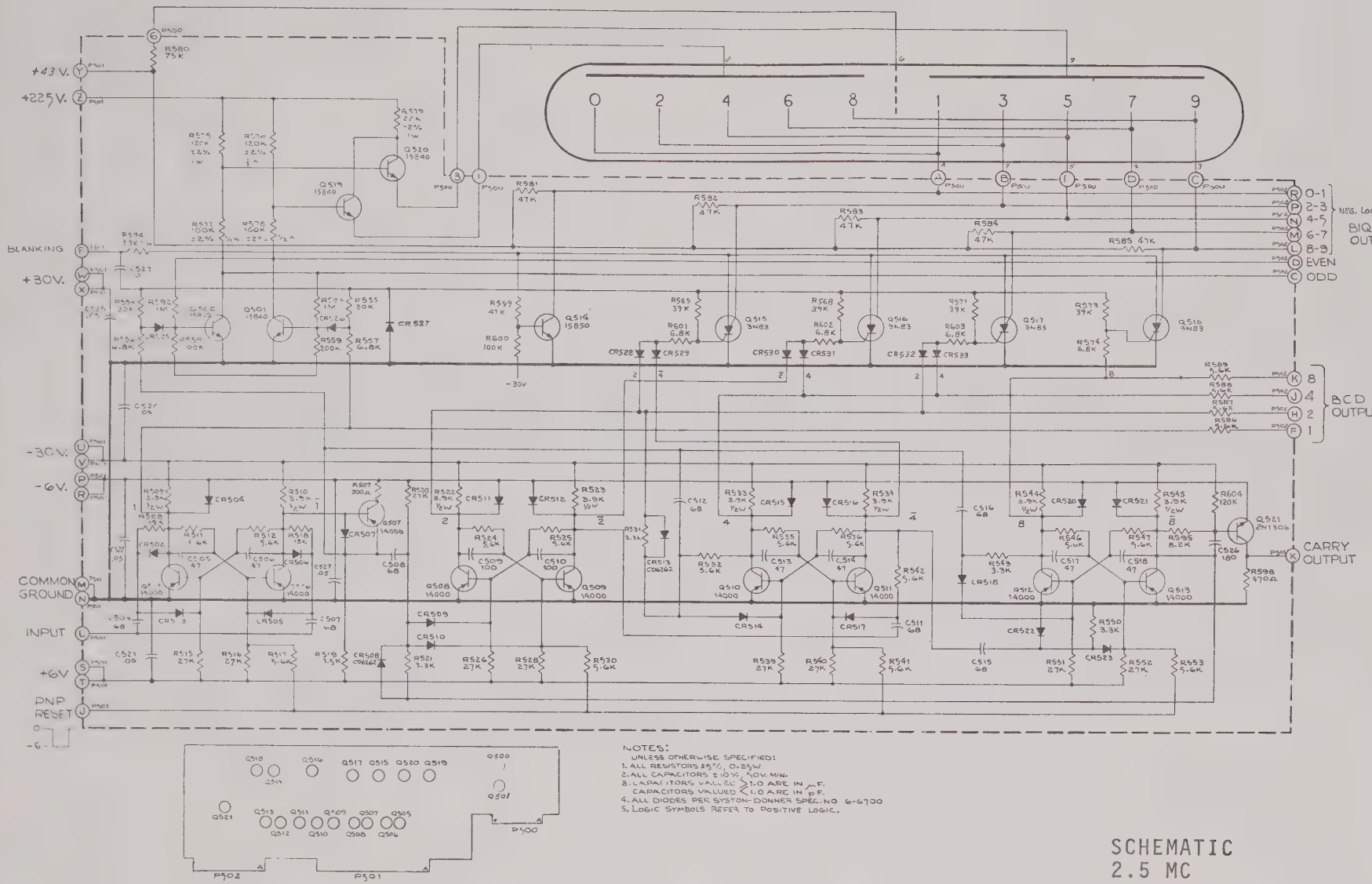
# SCHEMATIC
# 10 MHz
# STORAGE DECADE
# 15201




NOTE:
EXCEPT AS NOTED:
1) RESISTORS ¼ W 5%.
2) CAPACITORS GREATER THAN ONE (1) PF.
" LESS " " MF.
3) DIODES ARE 6700.

4) SCHEMATIC: 11528.
P/L 11527.

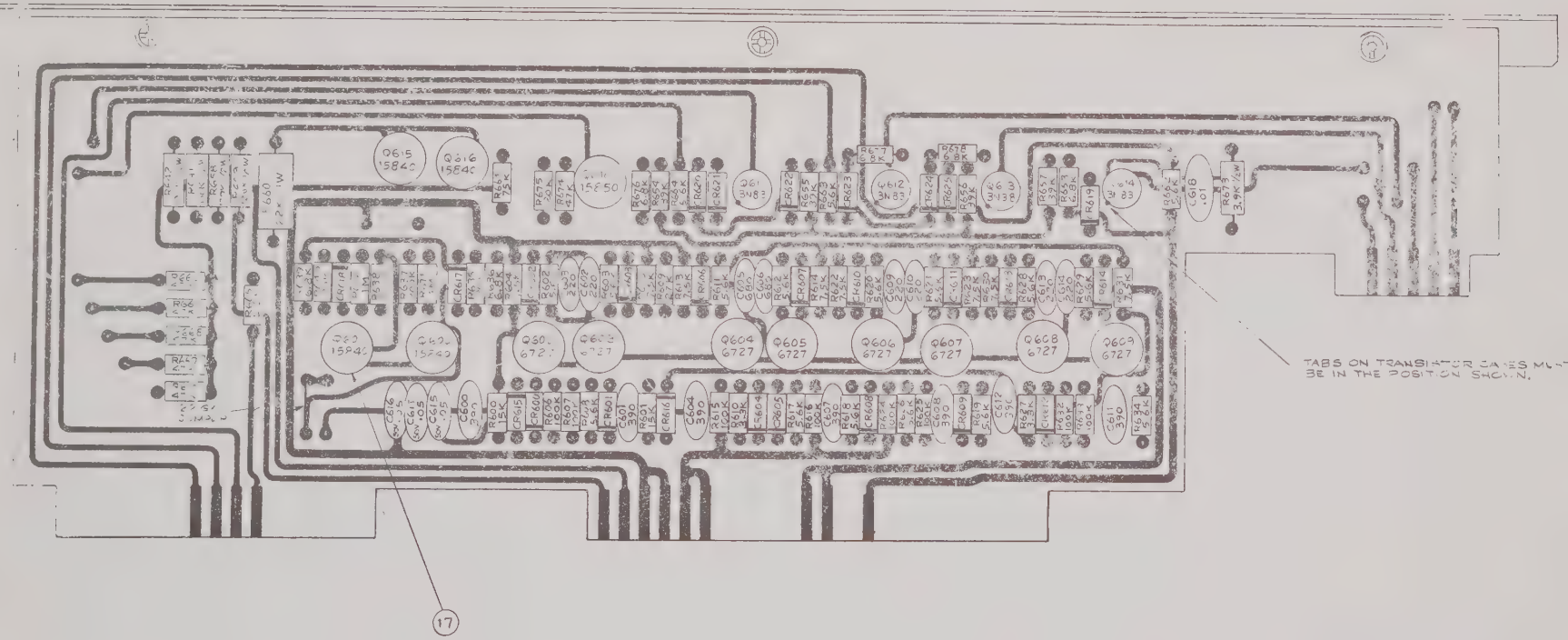
ASSEMBLY
2.5 MHz
DECADE
11527




NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ±5%, 0.25W
2. ALL CAPACITORS ±10%, 50V. MIN.
3. CAPACITORS VALUED ≥ 1.0 ARE IN μF.
   CAPACITORS VALUED < 1.0 ARE IN pF.
4. ALL DIODES PER SYSTON-DONNER SPEC. NO 6-6700
5. LOGIC SYMBOLS REFER TO POSITIVE LOGIC.

SCHEMATIC
2.5 MC
STORAGE DECADE
11528

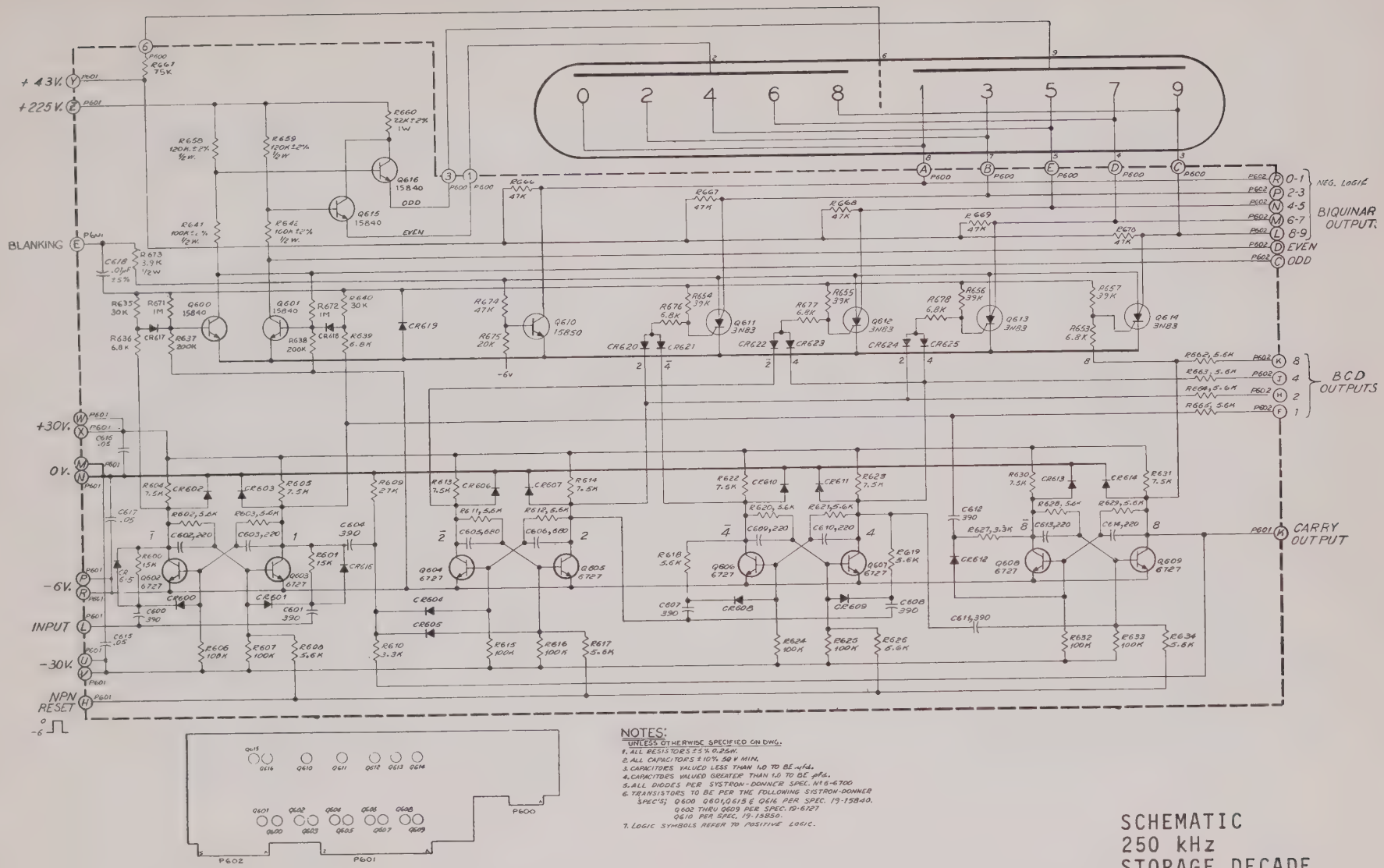
250 KC 11523




NOTE:

1) SCHEMATIC: 11524
2) PARTS LIST: PL 11523
3) ALL DIODES 6700.
4) CAPACITORS:
   LESS THAN ONE IN μF.
   GREATER THAN ONE IN pF.
5) RESISTORS: EXCEPT AS NOTED.
   ¼W 5%.

ASSEMBLY
250 kHz
DECADE
11523




NOTES:
UNLESS OTHERWISE SPECIFIED ON DWG.

1. ALL RESISTORS ±5% 0.25W.
2. ALL CAPACITORS ±10% 50 V MIN.
3. CAPACITORS VALUED LESS THAN 1.0 TO BE μfd.
4. CAPACITORS VALUED GREATER THAN 1.0 TO BE μfd.
5. ALL DIODES PER SYSTRON-DONNER SPEC. N16-6700
6. TRANSISTORS TO BE PER THE FOLLOWING SYSTRON-DONNER SPEC'S; Q600 Q601, Q615 & Q616 PER SPEC. 19-15840. Q602 THRU Q609 PER SPEC. 19-6727 Q610 PER SPEC. 19-15850.
7. LOGIC SYMBOLS REFER TO POSITIVE LOGIC.

SCHEMATIC
250 kHz
STORAGE DECADE
11524

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | 50 MHz Amp and Decade PC Ass'y | 13534 | |
| Q101 | Transistor, 14092 | 14092 | |
| Q102 | Transistor, 14092 | 14092 | |
| Q103 | Transistor, 14000 | 14000 | |
| Q104 | Transistor, 14092 | 14092 | |
| Q105 | Transistor, 14092 | 14092 | |
| Q106 | Transistor, 14092 | 14092 | |
| Q107 | Transistor, 14092 | 14092 | |
| Q108 | Transistor, 2N706 | Q0130 | |
| Q109 | Transistor, 14000 | 14000 | |
| Q110 | NOT USED | | |
| Q111 | Transistor, 14000 | 14000 | |
| Q112 | Transistor, 14000 | 14000 | |
| Q113 | Transistor, 14000 | 14000 | |
| Q114 | Transistor, 14000 | 14000 | |
| Q115 | Transistor, 14000 | 14000 | |
| Q116 | Transistor, 14000 | 14000 | |
| Q117 | Transistor, 2N2708 | Q0158 | |
| Q118 | Transistor, 14092 | 14092 | |
| Q119 | Transistor, 14092 | 14092 | |
| Q120 | Transistor, 14092 | 14092 | |
| Q121 | Transistor, 14092 | 14092 | |
| Q122 | Transistor, 14092 | 14092 | |
| Q123 | Transistor, 14092 | 14092 | |
| Q124 | Transistor, 14092 | 14092 | |
| Q125 | Transistor, 14092 | 14092 | |
| Q126 | Transistor, 2N706 | Q0130 | |
| Q127 | Transistor, 2N706 | Q0130 | |
| Q128 | Transistor, 14092 | 14092 | |
| Q129 | Transistor, 14092 | 14092 | |
| Q130 | Transistor, 14092 | 14092 | |
| Q131 | Transistor, 14092 | 14092 | |
| Q132 | Transistor, 14092 | 14092 | |
| Q133 | Transistor, 14092 | 14092 | |
| Q134 | Transistor, 14092 | 14092 | |
| CR101 | Diode, | CR0150 | |
| CR102 | Diode, 1N3605 | CR0189 | |
| CR103 | Diode, 1N3605 | CR0189 | |
| CR104 | Diode, 1N759 | CR0072 | |
| CR105 | Diode, 6700 | 6700 | |
| CR106 | Diode, 1N3605 | CR0189 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR107 | Diode, 6700 | 6700 | |
| CR108 | Diode, 6700 | 6700 | |
| CR109 | NOT USED | | |
| CR110 | Diode, Q6-100 | CR0194 | |
| CR111 | Diode, 1N3719 | CR0188 | |
| CR112 | Diode, 1N3719 | CR0188 | |
| CR113 | NOT USED | | |
| CR114 | Diode, 1N3719 | CR0188 | |
| CR115 | Diode, 1N3819 | CR0188 | |
| CR116 | Diode, 1N3719 | CR0188 | |
| CR117 | Diode, 1N3719 | CR0188 | |
| CR118 | Diode, 1N3719 | CR0188 | |
| CR119 | Diode, | CR0150 | |
| CR120 | Diode, | CR0150 | |
| C101 | Capacitor, 5.5-18 pF, trimmer | C0712 | |
| C102 | Capacitor, 5.5-18 pF, trimmer | C0712 | |
| C103 | Capacitor, 9-35 pF, trimmer | C0709 | |
| C104 | Capacitor, 27 pF, 500V | C0530 | |
| C105 | Capacitor, 5 pF, 500V | C0596 | |
| C106 | Capacitor, .05 µF, 12V | C0672 | |
| C107 | Capacitor, .05 µF, 12V | C0672 | |
| C108 | Capacitor, 47 pF, 500V | C0533 | |
| C109 | Capacitor, 10pF, 500V | C0527 | |
| C110 | Capacitor, 10 pF, 500V | C0527 | |
| C111 | Capacitor, 68 pF, 500V | C0635 | |
| C112 | Capacitor, .05 µF, 12V | C0672 | |
| C113 | Capacitor, 27 pF, 500V | C0530 | |
| C114 | Capacitor, 82 pF, 500V | C0535 | |
| C115 | NOT USED | | |
| C116 | Capacitor, 10 pF, 500V | C0527 | |
| C117 | Capacitor, 150 pF, 500V | C0537 | |
| C118 | Capacitor, .05 µF, 12V | C0672 | |
| C119 | Capacitor, .05 µF, 12V | C0672 | |
| C120 | Capacitor, .05 µF, 50V | C0708 | |
| C121 | Capacitor, .05µF, 12V | C0672 | |
| C122 | Capacitor, .05 µF, 50V | C0708 | |
| C123 | Capacitor, .05 µF, 50V | C0708 | |
| C124 | Capacitor, 82 pF, 500V | C0535 | |
| C125 | Capacitor, .01 µF, 50V | C0562 | |
| C126 | Capacitor, .05 µF, 12V | C0672 | |
| C127 | Capacitor, .05 µF, 12V | C0672 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| C128 | Capacitor, .05 µF, 12V | C0672 | |
| C129 | NOT USED | | |
| C130 | NOT USED | | |
| C131 | Capacitor, 0.1 µF, 10V | C0661 | |
| C132 | Capacitor, .05 µF, 12V | C0672 | |
| C133 | Capacitor, 15 pF, 500V | C0528 | |
| C134 | Capacitor, 15 pF, 500V | C0528 | |
| C135 | Capacitor, 15 pF, 500V | C0528 | |
| C136 | Capacitor, 22 pF, 500V | C0529 | |
| C137 | Capacitor, 22 pF, 500V | C0529 | |
| C138 | Capacitor, 22 pF, 500V | C0529 | |
| C139 | Capacitor, 22 pF, 500V | C0529 | |
| C140 | Capacitor, .05 µF, 12V | C0672 | |
| C141 | Capacitor, 47 pF, 500V | C0533 | |
| R3 | Resistor, 51Ω, 5%, 1/2W, cc | R1246 | Allen Bradley CB5105 |
| R101 | Resistor, 91k, 5%, 1/2W, cc | R0479 | Allen Bradley EB9135 |
| R102 | Resistor, 1 Meg, 5%, 1/2W, cc | R0150 | Allen Bradley EB1055 |
| R103 | Resistor, 1k, 5%, 1/2W, cc | R0278 | Allen Bradley EB1025 |
| R104 | Resistor, 10k, 5%, 1W, cc | R0879 | |
| R105 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R106 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R107 | Resistor, 9.1k, 5%, 1/4W, cc | R0776 | Allen Bradley CB9125 |
| R108 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R109 | Resistor, 2.7k, 5%, 1/4W, cc | R0937 | Allen Bradley CB2725 |
| R110 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R111 | Resistor, 75k, 5%, 1/4W, cc | R0976 | Allen Bradley CB7535 |
| R112 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R113 | Resistor, 240Ω, 5%, 1/4W, cc | R0835 | Allen Bradley CB2415 |
| R114 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R115 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R116 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R117 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R118 | Resistor, 560Ω, 5%, 1/4W, cc | R0819 | Allen Bradley CB5615 |
| R119 | Resistor, 430Ω, 5%, 1/4W, cc | R1667 | Allen Bradley CB4315 |
| R120 | Resistor, 390Ω, 5%, 1/4W, cc | R0880 | Allen Bradley CB3915 |
| R121 | Resistor, 560Ω, 5%, 1/4W, cc | R0819 | Allen Bradley CB5615 |
| R122 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R123 | Resistor, 27k, 5%, 1/4W, cc | R0824 | A-len Bradley CB2735 |
| R124 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R125 | Resistor, 220Ω, 5%, 1/4W, cc | R0760 | Allen Bradley 2215 |
| R126 | Resistor, 360Ω, 5%, 1/4W, cc | R1571 | CB3615 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R126 | Resistor, 360Ω, 5%, 1/4W, cc | R1571 | Allen Bradley CB3615 |
| R127 | Resistor, 560Ω, 5%, 1W, cc | R1668 | Allen Bradley CB5615 |
| R128 | Resistor, 270Ω, 5%, 1/4W, cc | R0694 | Allen Bradley CB2715 |
| R129 | Resistor, 300Ω, 5%, 1/4W, cc | R0770 | Allen Bradley CB3015 |
| C130 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2015 |
| C131 | Resistor, 270Ω, 5%, 1/4W, cc | R0694 | Allen Bradley CB2715 |
| C132 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| C133 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| C134 | Resistor, 4.3k, 5%, 1/4W, cc | R0702 | Allen Bradley CB4325 |
| C135 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| C136 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R137 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R138 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R139 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1025 |
| R140 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1025 |
| R141 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1025 |
| R142 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1025 |
| R143 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1025 |
| R144 | Resistor, 270Ω, 5%, 1/4W, cc | R0694 | Allen Bradley CB2715 |
| R145 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R146 | Resistor, 750Ω, 5%, 1/4W, cc | R1425 | Allen Bradley CB7515 |
| R147 | Resistor, 110Ω, 5%, 1/2W, cc | R0431 | Allen Bradley EB1115 |
| R148 | Resistor, 110Ω, 5%, 1/2W, cc | R0431 | Allen Bradley CB1115 |
| R149 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R150 | Resistor, 330Ω, 5%, 1/4W, cc | R0662 | Allen Bradley CB3315 |
| R151 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R152 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R153 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R154 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R155 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R156 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R157 | Resistor, 330Ω, 5%, 1/4W, cc | R0662 | Allen Bradley CB3315 |
| R158 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R159 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R160 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R161 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R162 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R163 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R164 | Resistor, 330Ω, 5%, 1/4W, cc | R0662 | Allen Bradley CB3315 |
| R165 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R166 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R167 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R168 | Resistor, 75Ω, 5%, 1/4W, cc | R1556 | Allen Bradley CB7505 |
| R169 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R170 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R171 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R172 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R173 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R174 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R175 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R176 | Resistor, 2k, 5%, 1/4W, cc | R0734 | Allen Bradley CB2025 |
| R177 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R178 | Resistor, 2k, 5%, 1/4W, cc | R0734 | Allen Bradley CB2025 |
| R179 | Resistor, 1.8k, 5%, 1/2W, cc | R0277 | Allen Bradley EB1825 |
| R180 | Resistor, 750Ω, 5%, 1/4W, cc | R1425 | Allen Bradley CB7515 |
| R181 | Resistor, factory select, 5%, 1/4W, cc | Rxxxx | Allen Bradley Type CB |
| R182 | Resistor, 82Ω, 5%, 1/4W, cc | R1059 | Allen Bradley CB8205 |
| R183 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R184 | Resistor, 82Ω, 5%, 1/4W, cc | R1059 | Allen Bradley CB8205 |
| R185 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R186 | Resistor, 82Ω, 5%, 1/4W, cc | R1059 | Allen Bradley CB8205 |
| R187 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R188 | Resistor, 82Ω, 5%, 1/4W, cc | R1059 | Allen Bradley CB8205 |
| R189 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R190 | Resistor, 82Ω, 5%, 1/4W, cc | R1059 | Allen Bradley CB8205 |
| R191 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R192 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R193 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R194 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1015 |
| R195 | Resistor, 560Ω, 5%, 1/4W, cc | R0819 | Allen Bradley CB5615 |
| R196 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R197 | Resistor, 270Ω, 5%, 1/4W, cc | R0694 | Allen Bradley CB2715 |
| R198 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R199 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R200 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | Allen Bradley EB2725 |
| R201 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R202 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R203 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R204 | Resistor, 2.2k, 5%, 1/4W, cc | R0749 | Allen Bradley CB2225 |
| R205 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R206 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R207 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R208 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R209 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley |
| R210 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R211 | Resistor, 510Ω, 5%, 1/4W, cc | R0984 | Allen Bradley |
| R212 | Resistor, 510Ω, 5%, 1/4W, cc | R0984 | Allen Bradley CB5115 |
| R213 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R214 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R215 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R216 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R217 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R218 | Resistor, factory select, 5%, 1/4W, cc | Rxxxx | Allen Bradley Type CB |
| R219 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| L101 | Coil, 24V | L0055 | |
| L102 | Coil, 24V | L0055 | |
| L103 | Coil, 24V | L0055 | |
| L104 | Coil, 24V | L0055 | |
| S101 | Switch, reed | S0132 | |
| S102 | Switch, reed | S0132 | |
| S103 | Switch, reed | S0132 | |
| S104 | Switch, reed | S0132 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | Power Supply P.C. Ass'y | 19681 | |
| Q101 | Transistor, 2N3251 | Q0174 | Motorola 2N3251 |
| Q102 | Transistor, 15700 | 15700 | Per SD spec 15700 |
| Q103 | Transistor, 2N1183 | Q0080 | RCA 2N1183 |
| Q104 | Transistor, 2N1183 | Q0080 | RCA 2N1183 |
| Q105 | Transistor, 2N2270 | Q0102 | RCA 2N2270 |
| Q106 | Transistor, 51700 | 15700 | Per SD spec 15700 |
| Q107 | Transistor, 2N1183 | Q0080 | RCA 2N1183 |
| Q108 | Transistor, 15840 | 15840 | Per SD spec 15840 |
| Q109 | Transistor, 2N2270 | Q0102 | RCA 2N2270 |
| Q110 | Transistor, 15840 | 15840 | Per SD spec 15840 |
| Q111 | Transistor, 15840 | 15840 | Per SD spec 15840 |
| Q112 | Transistor, 2N1671B | Q0084 | General Elect. 2N1671B |
| CR101 | Diode, 1N716 | CR0132 | IRC 1N716 |
| CR102 | Diode, 1N716 | CR0132 | IRC 1N716 |
| CR103 | Diode, 1N752A | CR0064 | Motorola 1N752A |
| CR104 | Diode, 1N751A | CR0095 | Motorola 1N751A |
| CR105 | Diode, 1N716 | CR0132 | IRC 1N716 |
| CR106 | NOT USED | | |
| CR107 | Diode, 6700 | 6700 | Per SD spec 6700 |
| CR108 | NOT USED | | |
| CR109 | NOT USED | | |
| CR110 | Diode, 6700 | 6700 | Per SD spec 6700 |
| CR111 | Diode, 6700 | 6700 | Per SD spec 6700 |
| CR112 | Diode, 6700 | 6700 | Per SD spec 6700 |
| CR113 | Diode, 1N4135 | CR0258 | Motorola 1N4135 |
| C101 | NOT USED | | |
| C102 | NOT USED | | |
| C103 | NOT USED | | |
| C104 | Capacitor, .05 µF, 100V, disc | C0708 | Sprague 55C23A7 |
| C105 | Capacitor, 20 µF, 50V, elect. | C0664 | Sprague 40D195A2 |
| C106 | Capacitor, 120 µF, 10V, tant | C0732 | Kemet K120-P10 |
| C107 | Capacitor, 120 µF, 10V, tant | C0732 | Kemet K120-P10 |
| C108 | NOT USED | | |
| C109 | Capacitor, .05 µF, 100V, disc | C0708 | Sprague S5C23A7 |
| C110 | Capacitor, 20 µF, 50V, elect. | C0664 | Sprague 40D195A2 |
| C111 | NOT USED | | |
| C112 | NOT USED | | |
| C113 | NOT USED | | |
| C114 | Capacitor, .05 µF, 100V, disc | C0708 | Sprague TG-S50 |
| C115 | Capacitor, .05 µF, 100V, disc | C0708 | Sprague TG-S50 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| C116 | Capacitor, .1 µF, 100V, mylar | C0786 | Electron 2DE1-104 |
| C117 | Capacitor, .005 µF, 150V, disc | C0325 | Centralab DDM502 |
| C118 | Capacitor, .005 µF, 150V, disc | C0325 | Centralab DDM502 |
| C119 | Capacitor, .1 µF, 100V mylar | C0786 | Electron 2DE1-104 |
| C120 | NOT USED | | |
| C121 | NOT USED | | |
| C122 | NOT USED | | |
| C123 | NOT USED | | |
| C124 | NOT USED | | |
| C125 | NOT USED | | |
| C126 | Capacitor, 3000pF, 500V, mica | C0759 | Elmenco DM19F302J |
| C127 | Capacitor, 1500pF, 500V, mica | C0760 | Elmenco DM19F152J |
| C128 | Capacitor, .01 µF, 400V, mylar | C0441 | Midwec Type 3 |
| C129 | Capacitor, 2000pF, 500V, mica | C0954 | Elmenco DM19F202J |
| C130 | Capacitor, .22 µF, 100V, mylar | C0632 | Marshall Induct. D1-224 |
| C131 | Capacitor, 4 µF, 60V, | C0417 | General Elect. 62F208G2 |
| R101 | Resistor, 180k, 5%, 2W, cc | R2365 | Allen Bradley HB1845 |
| R102 | Potentiometer, 10k, 1/2W | R1557 | Bourns 3067P-1-103 |
| R103 | Resistor, 15k, 5%, 1/2W, cc | R0474 | Allen Bradley EB1535 |
| R104 | Resistor, 180Ω, 5%, 1/2W, cc | R0725 | Allen Bradley EB1815 |
| R105 | Resistor, 270Ω, 5%, 1/2W, cc | R0365 | Allen Bradley EB2715 |
| R106 | NOT USED | | |
| R107 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R108 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R109 | Resistor, 100Ω, 5%, 1/2W, cc | R0466 | Allen Bradley EB1015 |
| R110 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | Allen Bradley EB2725 |
| R111 | Resistor, 2.2k, 5%, 1/2W, cc | R0259 | Allen Bradley EB2225 |
| R112 | Potentiometer, 2k, 1/2W | R1287 | Dale Series 2317 |
| R113 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R114 | NOT USED | | |
| R115 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | Allen Bradley EB2725 |
| R116 | Resistor, 270Ω, 5%, 3W, ww | R1868 | Sprague 242E2715 |
| R117 | NOT USED | | |
| R118 | Resistor, 560Ω, 5%, 1/2W, cc | R1083 | Allen Bradley EB5615 |
| R119 | NOT USED | | |
| R120 | Potentiometer, 500Ω, 1/2W | R1317 | Dale Series 2317 |
| R121 | Resistor, 3.3k, 1/2W, 5%, cc | R0136 | Allen Bradley EB3325 |
| R122 | Resistor, 560Ω, 5%, 1/2W, cc | R1083 | Allen Bradley EB5615 |
| R123 | NOT USED | | |
| R124 | Resistor, 560Ω, 5%, 1/2W, cc | R1083 | Allen Bradley EB5615 |
| R125 | NOT USED | | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R126 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R127 | Resistor, 5.6k, 5%, 1/2W, cc | R0526 | Allen Bradley EB5625 |
| R128 | Resistor, 100Ω, 5%, 1/2W, cc | R0466 | Allen Bradley EB1015 |
| R129 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | Allen Bradley EB2725 |
| R130 | Resistor, 2.2k, 5%, 1/2W, cc | R0259 | Allen Bradley EB2225 |
| R131 | Potentiometer, 2k, 1/2W | R1287 | Dale Series 2317 |
| R132 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R133 | NOT USED | | |
| R134 | NOT USED | | |
| R135 | NOT USED | | |
| R136 | NOT USED | | |
| R137 | NOT USED | | |
| R138 | NOT USED | | |
| R139 | NOT USED | | |
| R140 | NOT USED | | |
| R141 | NOT USED | | |
| R142 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R143 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R144 | NOT USED | | |
| R145 | NOT USED | | |
| R146 | NOT USED | | |
| R147 | NOT USED | | |
| R148 | NOT USED | | |
| R149 | NOT USED | | |
| R150 | Resistor, 120k, 5%, 1/2W, cc | R0293 | Allen Bradley EB1245 |
| R151 | Resistor, 43k, 5%, 1/2W, cc | R0230 | Allen Bradley EB4335 |
| R152 | Resistor, 100k, 5%, 1/2W, cc | R0352 | Allen Bradley EB1045 |
| R153 | NOT USED | | |
| R154 | NOT USED | | |
| R155 | NOT USED | | |
| R156 | NOT USED | | |
| R157 | Resistor, 620Ω, 5%, 1W, cc | R1590 | Allen Bradley GB6215 |
| R158 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R159 | Resistor, 1.1k, 5%, 1W, cc | R1669 | Allen Bradley GB1125 |
| R160 | Resistor, 240Ω, 5%, 2W, cc | R1295 | Allen Bradley HB2415 |
| R161 | Resistor, 56k, 10%, 2W, cc | R2179 | Allen Bradley HB5630 |
| R162 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R163 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R164 | Pctentiometer, 500Ω, 1/2W | R1317 | Dale Series 2317 |
| R165 | NOT USED | | |
| R166 | NOT USED | | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R166 | NOT USED | | |
| R167 | NOT USED | | |
| R168 | NOT USED | | |
| R169 | NOT USED | | |
| R170 | NOT USED | | |
| R171 | NOT USED | | |
| R172 | NOT USED | | |
| R173 | Resistor, 10k, 5%, 1/2W, cc | R0292 | Allen Bradley EB1035 |
| R174 | Resistor, 27k, 5%, 1/2W, cc | R0564 | Allen Bradley EB2735 |
| R175 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | Allen Bradley EB2725 |
| R176 | Resistor, 56k, 5%, 1/2W, cc | R0137 | Allen Bradley EB5635 |
| R177 | Resistor, 330Ω, 5%, 1/2W, cc | R0315 | Allen Bradley EB3315 |
| R178 | Resistor, 330Ω, 5%, 1/2W, cc | R0315 | Allen Bradley EB3315 |
| R179 | Resistor, 330Ω, 5%, 1/2W, cc | R0315 | Allen Bradley EB3315 |
| R180 | Resistor, 27k, 5%, 1/2W, cc | R0564 | Allen Bradley EB2735 |
| R181 | Resistor, 22k, 5%, 1/2W, cc | R0527 | Allen Bradley EB2235 |
| R182 | Resistor, 1.8k, 10%, 1W, cc | R0643 | Allen Bradley GB1820 |
| R183 | Resistor, 68k, 5%, 1/2W, cc | R0273 | Allen Bradley EB6835 |
| R184 | Resistor, 1k, 5%, 1/2W, cc | R0278 | Allen Bradley EB1025 |
| R185 | Resistor, 150Ω, 5%, 1/4W, cc | R0983 | Allen Bradley CB1515 |
| R186 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R187 | Resistor, 56k, 10%, 2W, cc | R2179 | Allen Bradley HB5630 |
| R188 | Resistor, 56k, 5%, 1W, cc | R1102 | Allen Bradley EB3905 |
| R189 | Resistor, 30Ω, 5%, 1/2W, cc | R0724 | Allen Bradley EB3905 |
| R190 | Resistor, 27k, 5%, 1/2W, cc | R0564 | Allen Bradley EB2735 |

## MAIN CHASSIS POWER SUPPLY ASSEMBLY

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| Q1 | Transistor, 17321 | 17321 | Per SD spec 17321 |
| Q2 | Transistor, 2N1546 | Q0170 | Motorola 2N1546 |
| Q3 | Transistor, 40251 | Q0166 | RCA 40251 |
| Q4 | Transistor, 2N1546 | Q0170 | Motorola 2N1546 |
| Q5 | Transistor, 2N1546 | Q0170 | Motorola 2N1546 |
| CR1 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR2 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR3 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR4 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR5 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR6 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR7 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR8 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR9 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR10 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR11 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| CR12 | Diode, 1N4005 | CR0284 | ITT 1N4005 |
| C1 | Capacitor, 33 µF, 400V, elect. | 13491 | Per SD spec 13491 |
| C2 | Capacitor, 1000 µF, 65V, elect. | 13490 | Per SD spec 13490 |
| C3A | Capacitor, 1000 µF, 50V, elect. | C0800 | Sangamo 505-3802-01 |
| C4 | Capacitor, 1000 µF, 65V, elect. | 13490 | Per SD spec 13490 |
| C5 | Capacitor, 1000 µF, 65V, elect. | 13490 | Per SD spec 13490 |
| R1 | Resistor, 10Ω, 1/2W, 5%, cc | R1084 | Allen Bradley EB1005 |
| R2 | Resistor, 2Ω, 5W, 5%, ww | R1960 | Lectrohm C5 Series |
| R3 | Resistor, 2Ω, 5W, 5%, ww | R1960 | Lectrohm C5 Series |
| R4 | Resistor, 2Ω, 5W, 5%, ww | R1960 | Lectrohm C5 Series |
| R5 | Resistor, 2Ω, 5W, 5%, ww | R1960 | Lectrohm C5 Series |
| F1 | Fuse, .25A, 3AG | F0043 | Littlefuse 312.250 |
| F2 | Fuse, 1A, 3AG | F0001 | Littlefuse 312001 |
| F3 | Fuse, 1A, 3AG | F0001 | Littlefuse 312001 |
| F4 | Fuse, 1A, 3AG | F0001 | Littlefuse 312001 |
| F5 | Fuse, 1A, 3AG | F0001 | Littlefuse 312001 |
| T1 | Transformer, 12740 | 12740 | Per SD spec 12740 |

## MULTIPLIER

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | Multiplier P.C. Ass'y | 17966 | |
| Q1 | Transistor, 2N706 | Q0130 | |
| Q2 | Transistor, 2N706 | Q0130 | |
| Q3 | Transistor, 2N706 | Q0130 | |
| Q4 | Transistor, 2N706 | Q0130 | |
| Q5 | Transistor, 2N706 | Q0130 | |
| Q6 | Transistor, 14000 | 14000 | |
| Q7 | Transistor, 14000 | 14000 | |
| Q8 | Transistor, 14000 | 14000 | |
| Q9 | Transistor, 14000 | 14000 | |
| Q10 | Transistor, 14000 | 14000 | |
| CR1 | Diode, 6262 | CR0150 | |
| CR2 | Diode, 6700 | 6700 | |
| CR3 | Diode, 6262 | CR0150 | |
| CR4 | Diode, 6700 | 6700 | |
| CR5 | Diode, 6262 | CR0150 | |
| C1 | Capacitor, .01 µF | C0562 | |
| C2 | Capacitor, 150 pF | C0537 | |
| C3 | Capacitor, .05 µF | C0708 | |
| C4 | Capacitor, 1000 pF | C0543 | |
| C5 | Capacitor, .1 µF | C0734 | |
| C6 | Capacitor, 1000 pF | C0543 | |
| C7 | Capacitor, 3000 pF | C0759 | |
| C8 | Capacitor, 1000 pF | C0543 | |
| C9 | Capacitor, .01 µF | C0652 | |
| C10 | Capacitor, 1000 pF | C0543 | |
| C11 | Capacitor, 220 pF | C0538 | |
| C12 | Capacitor, 5 pF | C0596 | |
| C13 | Capacitor, .1 µF | C0734 | |
| C14 | Capacitor, 180 pF | C0643 | |
| C15 | Capacitor, .1 µF | C0734 | |
| C16 | Capacitor, .1 µF | C0734 | |
| C17 | Capacitor, 10 pF | C0527 | |
| C18 | Capacitor, 47 pF | C0533 | |
| C19 | Capacitor, 33 pF | C0531 | |
| C20 | Capacitor, 1000 pF | C0543 | |
| R1 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R2 | Resistor, 18k, 5%, 1/4W, cc | R0785 | Allen Bradley CB1835 |
| R3 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R4 | Resistor, 2.7k, 5%, 1/4W, cc | R0937 | Allen Bradley CB2725 |
| R5 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R6 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R7 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R8 | Resistor, 680Ω, 5%, 1/4W, cc | R1234 | Allen Bradley CB6815 |
| C9 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R10 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R11 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R12 | Resistor, 150Ω, 5%, 1/4W, cc | R0983 | Allen Bradley CB1515 |
| R13 | Resistor, 5.6k, 5%, 1/4W, cc | R0827 | Allen Bradley CB5625 |
| R14 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R15 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R16 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB7415 |
| R17 | Resistor, 5.6k, 5%, 1/4W, cc | R0827 | Allen Bradley CB5625 |
| R18 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R19 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R20 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R21 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R22 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R23 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R24 | Resistor, 1k, 10%, 2W, cc | R0330 | |
| R25 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R26 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R27 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R28 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R29 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R30 | Resistor, 30Ω, 5%, 1/4W, cc | R1549 | Allen Bradley CB3005 |
| R31 | Resistor, 5.6k, 5%, 1/4W, cc | R0827 | Allen Bradley CB5625 |
| R32 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R33 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R34 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| L1 | Inductor, variable, .87 µH-1.30 µH | 15320-1 | |
| L2 | Inductor, variable, .87 µH-1.30µH | 15320-1 | |
| L3 | Inductor, variable, .87 µH-1.30µH | 15320-1 | |
| L4 | Inductor, 270 µH | L0067 | |
| L5 | Inductor, variable, .87 µH-1.30 µH | 15320-3 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | Time Base P.C. Ass'y | 15422 | |
| Q1 | Transistor, 14000 | 14000 | |
| Q2 | Transistor, 14000 | 14000 | |
| Q3 | Transistor, 14000 | 14000 | |
| Q4 | Transistor, 14000 | 14000 | |
| Q5 | Transistor, 14000 | 14000 | |
| Q6 | Transistor, 14000 | 14000 | |
| Q9-2-3-4 | Transistor, 15700 | 15700 | |
| Q10-2-3-4 | Transistor, 15700 | 15700 | |
| Q11-2-3-4 | Transistor, 15700 | 15700 | |
| Q12-2-3-4 | Transistor, 15700 | 15700 | |
| Q13-2-3-4 | Transistor, 15700 | 15700 | |
| Q14-2-3-4 | Transistor, 15700 | 15700 | |
| Q15-2-3-4 | Transistor, 15700 | 15700 | |
| Q16-2-3-4 | Transistor, 15700 | 15700 | |
| Q17 | Transistor, 14000 | 14000 | |
| Q18 | Transistor, 14000 | 14000 | |
| Q19 | Transistor, 14000 | 14000 | |
| Q20 | Transistor, 14000 | 14000 | |
| Q21 | Transistor, 2N3640 | Q0178 | |
| CR1 | Diode, 6262 | CR0150 | |
| CR2 | Diode, 6262 | CR0150 | |
| CR3 | Diode, 6262 | CR0150 | |
| CR4 | Diode, 6700 | 6700 | |
| CR5 | Diode, 6262 | CR0150 | |
| CR6 | Diode, 6262 | CR0150 | |
| CR7 | Diode, 6700 | | |
| CR8 | Diode, 6700 | 6700 | |
| CR9 | Diode, 6262 | CR0150 | |
| CR10 | NOT USED | | |
| CR11 | Diode, 6700 | 6700 | |
| CR12 | Diode, 6700 | 6700 | |
| CR13 | Diode, 6700 | 6700 | |
| CR14 | NOT USED | | |
| CR15 | NOT USED | | |
| CR16 | NOT USED | | |
| CR17 | NOT USED | | |
| CR18 | NOT USED | | |
| CR19 | NOT USED | | |
| CR20 | NOT USED | | |
| CR21 | NOT USED | | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR22-2-3-4 | Diode, 6262 | CR0150 | |
| CR23-2-3-4 | Diode, 6700 | 6700 | |
| CR24-2-3-4 | Diode, 6700 | 6700 | |
| CR25-2-3-4 | Diode, 6262 | CR0150 | |
| CR26-2-3-4 | Diode, 6700 | 6700 | |
| CR27-2-3-4 | Diode, 6700 | 6700 | |
| CR28-2-3-4 | Diode, 6700 | 6700 | |
| CR29-2-3-4 | Diode, 6700 | 6700 | |
| CR30-2-3-4 | Diode, 6700 | 6700 | |
| CR31 | Diode, 6700 | 6700 | |
| C1 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C2 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C3 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C4 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C5 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C6 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C7 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C8 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C9 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C10 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C11 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C12 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C13 | Capacitor, 27 pF, 500V, mica | C0530 | |
| C14 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C15-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C16-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C17-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C18-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C19-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C20-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C21-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C22-2-3-4 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C23-2-3-4 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C24-2-3-4 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C25-2-3-4 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C26-2-3-4 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C27 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C28 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C29 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C30 | NOT USED | | |
| C31 | Capacitor, .01 μF, 50V, disc | C0562 | |

TIME BASE (con't.)

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| C32 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C33 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C34 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C35 | Capacitor, 150 pF, 500V, mica | C0537 | |
| R1 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R2 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R3 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R5 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R6 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R7 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R8 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R9 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R10 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R11 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R12 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R13 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R14 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R15 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R16 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R17 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R18 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R19 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R20 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R21 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R22 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R23 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R24 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R25 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R26 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R27 | Resistor, 1.5k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R28 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R29 | NOT USED | | |
| R30-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R31-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R32-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R33-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R34-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R35-2-3-4 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R36-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R37-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R38-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R39-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R40-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R41-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R42-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R43-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R44-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R45-2-3-4 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R46-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R47-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R48-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R49-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R50-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R51-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R52-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R53-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R54-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R55-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R56-2-3-4 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R57-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R58-2-3-4 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R59 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R60 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R61 | Resistor, 18k, 5%, 1/4W, cc | R0785 | Allen Bradley CB1835 |
| R62 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R63 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R64 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R65 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R66 | Resistor, 2.7k, 5%, 1/4W, cc | R0937 | Allen Bradley CB2725 |
| R67 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R68 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R69 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R70 | Resistor, 1.2k, 5%, 1/4W, cc | R0809 | Allen Bradley CB1225 |
| R71 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R72 | Resistor, 18k, 5%, 1/4W, cc | R0785 | Allen Bradley CB1835 |
| R73 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley CB3925 |
| R74 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R75 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R76 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |

## DISPLAY AND RESET

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | Display and Reset P.C. Ass'y | 19243 | |
| Q1 | Transistor, 51700 | 15700 | |
| Q2 | Transistor, 15700 | 15700 | |
| Q3 | Transistor, 14000 | 14000 | |
| Q4 | Transistor, 14000 | 14000 | |
| Q5 | Transistor, 14000 | 14000 | |
| Q6 | Transistor, 14000 | 14000 | |
| Q7 | Transistor, 6727 | 6727 | |
| Q8 | Transistor, 15700 | 15700 | |
| Q9 | Transistor, 15700 | 15700 | |
| Q10 | Transistor, 2N697 | Q0028 | |
| Q11 | Transistor, 2N1671B | Q0084 | |
| Q12 | Transistor, 15700 | 15700 | |
| Q13 | Transistor, 15700 | 15700 | |
| Q14 | Transistor, 6727 | 6727 | |
| Q15 | Transistor, 15700 | 15700 | |
| Q16 | Transistor, 2N706 | Q0130 | |
| Q17 | Transistor, 14000 | 14000 | |
| Q18 | Transistor, 14000 | 14000 | |
| Q19 | Transistor, 14000 | 14000 | |
| Q20 | Transistor, 14000 | 14000 | |
| Q21 | Transistor, 14000 | 14000 | |
| Q22 | Transistor, 14000 | 14000 | |
| Q23 | Transistor, 14000 | 14000 | |
| Q24 | Transistor, 14000 | 14000 | |
| Q25 | Transistor, 15700 | 15700 | |
| Q26 | Transistor, 15700 | 15700 | |
| Q27 | Transistor, 15700 | 15700 | |
| Q28 | Transistor, 15700 | 15700 | |
| Q29 | Transistor, 15700 | 15700 | |
| Q30 | Transistor, 15700 | 15700 | |
| Q31 | Transistor, 15700 | 15700 | |
| Q32 | Transistor, 15700 | 15700 | |
| Q33 | Transistor, 15700 | 15700 | |
| Q34 | Transistor, 15700 | 15700 | |
| Q35 | Transistor, 15700 | 15700 | |
| Q36 | Transistor, 14000 | 14000 | |
| Q37 | Transistor, 14000 | 14000 | |
| CR1 | Diode, 6262 | CR0150 | |
| CR2 | Diode, 6262 | CR0150 | |
| CR3 | Diode, 6262 | CR0150 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR4 | Diode, 6262 | CR0150 | |
| CR5 | Diode, 6262 | CR0150 | |
| CR6 | Diode, 6262 | CR0150 | |
| CR7 | Diode, 6700 | 6700 | |
| CR9 | NOT USED | | |
| CR10 | Diode, 6262 | CR0150 | |
| CR11 | Diode, 6262 | CR0150 | |
| CR12 | Diode, 6262 | CR0150 | |
| CR13 | Diode, 6262 | CR0150 | |
| CR14 | Diode, 6262 | CR0150 | |
| CR15 | Diode, 6262 | CR0150 | |
| CR16 | Diode, 6262 | CR0150 | |
| CR17 | Diode, 6262 | CR0150 | |
| CR18 | Diode, 6262 | CR0150 | |
| CR19 | Diode, 6262 | CR0150 | |
| CR20 | Diode, 6262 | CR0150 | |
| CR21 | Diode, 6700 | 6700 | |
| CR22 | Diode, 6700 | 6700 | |
| CR23 | Diode, 6700 | 6700 | |
| CR24 | Diode, 6700 | 6700 | |
| CR25 | Diode, 6700 | 6700 | |
| CR26 | Diode, 6700 | 6700 | |
| CR27 | Diode, 6700 | 6700 | |
| CR28 | Diode, 6262 | CR0150 | |
| CR29 | Diode, 6262 | CR0150 | |
| CR30 | Diode, 6700 | 6700 | |
| CR31 | Diode, 6262 | CR0150 | |
| CR32 | Diode, 6262 | CR0150 | |
| CR33 | Diode, 6262 | CR0150 | |
| CR34 | Diode, 6700 | 6700 | |
| CR35 | Diode, 6262 | CR0150 | |
| CR36 | Diode, 6262 | CR0150 | |
| CR37 | Diode, 6700 | 6700 | |
| CR38 | Diode, 6700 | 6700 | |
| C1 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C2 | Capacitor, .47 µF | C0733 | |
| C3 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C4 | Capacitor, 27 pF, 500V, mica | C0530 | |
| C5 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C6 | Capacitor, 27 pF, 500V, mica | C0530 | |
| C7 | Capacitor, 100 pF, 500V, mica | C0536 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| C8 | Capacitor, 4.7 µF | C0406 | |
| C9 | Capacitor, .1 µF | C0236 | |
| C10 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C11 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C12 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C13 | Capacitor, 3.9 µF, 35V, | C0890 | |
| C14 | Capacitor, 35 pF, 500V, mica | C0531 | |
| C15 | Capacitor, 82 pF, 500V, mica | C0535 | |
| C16 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C17 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C18 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C19 | Capacitor, 82 pF, 500V, mica | C0535 | |
| C20 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C21 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C22 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C23 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C24 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C25 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C26 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C27 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C28 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C29 | Capacitor, 270 pF, 500 V, mica | C0539 | |
| C30 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C31 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C32 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C33 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C34 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C35 | Capacitor, 270 pF, 500V, mica | C0539 | |
| C36 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C37 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C38 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C39 | Capacitor, 150 pF, 500V, mica | C0537 | |
| C40 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C41 | Capacitor, .001 µF, | C0235 | |
| C42 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C43 | Capacitor, 4.7 µF | C0406 | |
| C44 | Capacitor, .001 µF | C0235 | |
| R1 | Resistor, 680Ω, 5%, 1/4W, cc | R1234 | Allen Bradley CB6815 |
| R2 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R3 | Resistor, 680Ω, 5%, 1/4W, cc | R1234 | Allen Bradley CB6815 |
| R4 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R5 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R6 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R7 | Resistor, 390Ω, 5%, 1/4W, cc | R0880 | Allen Bradley CB3915 |
| R8 | Resistor, 390Ω, 5%, 1/4W, cc | R0880 | Allen Bradley CB3915 |
| R9 | Resistor, 390Ω, 5%, 1/4W, cc | R0880 | Allen Bradley CB3915 |
| R10 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R11 | Resistor, 2.7k, 5%, 1/2W, cc | R0143 | |
| R12 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R13 | Resistor, 680Ω, 5%, 1/4W, cc | R1234 | Allen Bradley CB6815 |
| R14 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R15 | Resistor, 680Ω, 5%, 1/4W, cc | R1234 | Allen Bradley CB6815 |
| R16 | Resistor, 560Ω, 5%, 1/4W, cc | R0819 | Allen Bradley CB5615 |
| R17 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R18 | Resistor, 330Ω, 5%, 1/4W, cc | R0662 | Allen Bradley CB3315 |
| R19 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R20 | Resistor, 2.2k, 5%, 1/2W, cc | R0259 | Allen Bradley EB2225 |
| R21 | Resistor, 560Ω, 5%, 1/4W, cc | R0819 | Allen Bradley CB5615 |
| R22 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R23 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R24 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R25 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R26 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R27 | Resistor, 10Ω, 5%, 1/4W, cc | R0739 | Allen Bradley CB1005 |
| R28 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R29 | Resistor, 2.2k, 5%, 1/4W, cc | R0749 | Allen Bradley CB2225 |
| R30 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB6525 |
| R31 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R32 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R33 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R34 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R35 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R36 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R37 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R38 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R39 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R40 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R41 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R42 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R43 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R44 | Resistor, 33k, 5%, 1/4W, cc | R0780 | Allen Bradley CB3335 |
| R45 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R46 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R47 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R48 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R49 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R50 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R51 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R52 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R53 | Resistor, 1k, 5%, 1/4W, cc | R0765 | Allen Bradley CB1025 |
| R54 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R55 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R56 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R57 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R58 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R59 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R60 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R61 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R62 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R63 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R64 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R65 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R66 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R67 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R68 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R69 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R70 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R71 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R72 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R73 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R74 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R75 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R76 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R77 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R78 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R49 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R80 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R81 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R82 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R83 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R84 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R85 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R86 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R87 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R88 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R89 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R90 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R91 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R92 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R93 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R94 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R95 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R96 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R97 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R98 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R99 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R100 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R101 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R102 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R103 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R104 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R105 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R106 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R107 | Resistor, 12k, 5%, 1/4W, cc | R0759 | Allen Bradley CB1235 |
| R108 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R109 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R110 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R111 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R112 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R113 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R114 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R115 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R116 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R117 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R118 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R119 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R120 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R121 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R122 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R123 | Resistor, 22k, 5%, 1/4W, cc | R0768 | Allen Bradley CB2235 |
| R124 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R125 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R126 | Resistor, 82k, 5%, 1/4W, cc | R0784 | Allen Bradley CB8235 |
| R127 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R128 | Resistor, 33k, 5%, 1/4W, cc | R0780 | Allen Bradley CB3335 |
| R129 | NOT USED | | |
| R130 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R131 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R132 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R133 | Resistor, 100Ω, 5%, 1/4W, cc | R0966 | Allen Bradley CB1015 |
| R134 | Resistor, 10k, 5%, 1/4W, cc | R0677 | Allen Bradley CB1035 |
| R135 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R136 | Resistor, 47Ω, 5%, 1/4W, cc | R0743 | Allen Bradley CB4705 |
| R137 | Resistor, 1.8k, 5%, 1/4W, cc | R0959 | Allen Bradley CB1825 |
| R138 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R139 | Resistor, 820Ω, 5%, 1/4W, cc | R0762 | Allen Bradley CB8215 |
| R140 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |

| REFERENCE | DESCRIPTION | PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | 50 MHz Readout P.C. Ass'y | 12979 | |
| Q401 | NOT USED | | |
| Q402 | NOT USED | | |
| Q403 | Transistor, 2N1304 | Q0073 | |
| Q404 | Transistor, 2N1304 | Q0073 | |
| Q405 | Transistor, 2N1304 | Q0073 | |
| Q406 | Transistor, 2N1304 | Q0073 | |
| Q407 | Transistor, 2N1304 | Q0073 | |
| Q408 | Transistor, 2N1304 | Q0073 | |
| Q409 | Transistor, 2N1304 | Q0073 | |
| Q410 | Transistor, 2N1304 | Q0073 | |
| Q411 | Transistor, 2N1304 | Q0073 | |
| Q412 | Transistor, 2N1304 | Q0073 | |
| Q413 | Transistor, 2N1304 | Q0073 | |
| Q414 | Transistor, 2N1304 | Q0073 | |
| Q415 | Transistor, 2N1304 | Q0073 | |
| Q416 | Transistor, 2N1304 | Q0073 | |
| Q417 | Transistor, 15840 | 15840 | |
| Q418 | Transistor, 15840 | 15840 | |
| Q419 | Transistor, 15840 | 15840 | |
| Q420 | Transistor, 15840 | 15840 | |
| Q421 | Transistor, 3N83 | Q0193 | |
| Q422 | Transistor, 3N83 | Q0193 | |
| Q423 | Transistor, 15850 | 15850 | |
| Q424 | Transistor, 3N83 | Q0193 | |
| Q425 | Transistor, 3N83 | Q0193 | |
| CR401 | Diode, 6700 | 6700 | |
| CR402 | Diode, 6700 | 6700 | |
| CR403 | Diode, 6700 | 6700 | |
| CR404 | Diode, 6700 | 6700 | |
| CR405 | Diode, 6700 | 6700 | |
| CR406 | Diode, 6700 | 6700 | |
| CR407 | Diode, 6700 | 6700 | |
| CR408 | Diode, 6700 | 6700 | |
| CR409 | Diode, 6700 | 6700 | |
| CR410 | Diode, 6700 | 6700 | |
| CR411 | Diode, 6700 | 6700 | |
| CR412 | Diode, 6700 | 6700 | |
| CR413 | Diode, 6700 | 6700 | |
| CR414 | Diode, 6700 | 6700 | |
| CR415 | Diode, 6700 | 6700 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR416 | Diode, 6700 | 6700 | |
| CR417 | Diode, 6700 | 6700 | |
| CR418 | Diode, 6700 | 6700 | |
| CR419 | Diode, 6700 | 6700 | |
| CR420 | Diode, 6700 | 6700 | |
| CR421 | Diode, 6700 | 6700 | |
| CR422 | Diode, 6700 | 6700 | |
| CR423 | Diode, 6700 | 6700 | |
| CR424 | Diode, 6700 | 6700 | |
| CR425 | Diode, 6700 | 6700 | |
| CR426 | Diode, 6700 | 6700 | |
| CR427 | Diode, 6700 | 6700 | |
| CR428 | Diode, 6700 | 6700 | |
| CR429 | Diode, 6700 | 6700 | |
| CR230 | Diode, 6700 | 6700 | |
| CR431 thru CR455 | NOT USED | | |
| CR456 | Diode, 6700 | 6700 | |
| CR457 | Diode, 6700 | 6700 | |
| CR458 | Diode, 6700 | 6700 | |
| CR459 | Diode, 6700 | 6700 | |
| CR460 | Diode, 6700 | 6700 | |
| CR461 | Diode, 6700 | 6700 | |
| CR462 | Diode, 6700 | 6700 | |
| CR463 | Diode, 6700 | 6700 | |
| CR464 | Diode, 6700 | 6700 | |
| CR465 | Diode, 6700 | 6700 | |
| CR466 | Diode, 6700 | 6700 | |
| CR467 | Diode, 6700 | 6700 | |
| CR468 | Diode, 6700 | 6700 | |
| CR469 | Diode, 6700 | 6700 | |
| CR470 | Diode, 6700 | 6700 | |
| C101 | Capacitor, .01 µF, 50V | C0705 | |
| R401 | NOT USED | | |
| R402 | NOT USED | | |
| R403 | NOT USED | | |
| R404 | NOT USED | | |
| R405 | NOT USED | | |
| R406 | NOT USED | | |
| R407 | NOT USED | | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R408 | NOT USED | | |
| R409 | Resistor, 18k, 5%, 1/4W, cc | R0785 | Allen Bradley CB1835 |
| R410 | Resistor, 15k, 5%, 1/2W, cc | R0474 | Allen Bradley EB1535 |
| R411 | Resistor, 3k, 5%, 1/4W, cc | R0711 | Allen Bradley CB3025 |
| R412 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R413 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R414 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R415 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R416 | Resistor, 3k, 5%, 1/4W, cc | R0711 | Allen Bardley CB3025 |
| R417 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R418 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R419 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R420 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R421 | Resistor, 3k, 5%, 1/4W, cc | R0711 | Allen Bradley CB3025 |
| R422 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R423 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R424 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R425 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R426 | Resistor, 3k, 5%, 1/4W, cc | R0711 | Allen Bradley CB3025 |
| R427 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R428 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R429 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R430 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R431 | Resistor, 8k, 5%, 1/4W, cc | R0711 | Allen Bradley CB3025 |
| R432 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R433 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R434 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R435 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R436 | Resistor, 3k, 5%, 1/4W, cc | R0711 | Allen Bradley CB3025 |
| R437 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R438 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R439 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R440 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R441 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R442 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R443 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R444 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R445 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R446 | Resistor, 10k, 5%, 1/4W, cc | R0766 | Allen Bradley CB1035 |
| R447 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R448 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |

| REFERENCE | DESCRIPTION | PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R449 | Resistor, 6.2k, 5%, 1/4W, cc | R0965 | Allen Bradley CB6225 |
| R450 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R451 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R452 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R453 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R454 | Resistor, 6.2k, 5%, 1/4W, cc | R0965 | Allen Bradley CB6225 |
| R455 | Resistor, 100k, 2%, 1/2W | R1498 | |
| R456 | Resistor, 120k, 2%, 1/2W | R1499 | |
| R457 | Resistor, 100k, 2%, 1/2W, | R1498 | |
| R458 | Resistor, 120k, 2%, 1/2W | R1499 | |
| R459 | Resistor, 22k, 2%, 1W | R1596 | |
| R460 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R461 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R462 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R463 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R464 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R465 | NOT USED | | |
| R466 | NOT USED | | |
| R467 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R468 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R469 | NOT USED | | |
| R470 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R471 | NOT USED | | |
| R472 | NOT USED | | |
| R473 | NOT USED | | |
| R474 | Resistor, 39k, 5%, 1/4W, cc | R0478 | Allen Bradley CB3935 |
| R475 | NOT USED | | |
| R476 | NOT USED | | |
| R477 | NOT USED | | |
| R478 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R479 | Resistor, 75k, 5%, 1/4W, cc | R0976 | Allen Bradley CB7535 |
| R480 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R481 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R482 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R483 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R484 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R485 | NOT USED | | |
| R486 | NOT USED | | |
| R487 | NOT USED | | |
| R488 | NOT USED | | |
| R489 | NOT USED | | |

| REFERENCE | DESCRIPTION | PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R490 | NOT USED | | |
| R491 | NOT USED | | |
| R492 | NOT USED | | |
| R493 | NOT USED | | |
| R494 | NOT USED | | |
| R495 | NOT USED | | |
| R496 | NOT USED | | |
| R497 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R498 | Resistor, 1 Meg. 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R499 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |

## 10 MHz DECADE

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | 10 MHz Decade P.C. Ass'y | 15200 | |
| Q400 | Transistor, 15840 | 15840 | |
| Q401 | Transistor, 15840 | 15840 | |
| Q402 | NOT USED | | |
| Q403 | NOT USED | | |
| Q404 | NOT USED | | |
| Q405 | Transistor, 14000 | 14000 | |
| Q406 | Transistor, 14000 | 14000 | |
| Q407 | Transistor, 14000 | 14000 | |
| Q408 | Transistor, 14000 | 14000 | |
| Q409 | Transistor, 14000 | 14000 | |
| Q410 | Transistor, 14000 | 14000 | |
| Q411 | Transistor, 14000 | 14000 | |
| Q412 | Transistor, 14000 | 14000 | |
| Q413 | Transistor, 14000 | 14000 | |
| Q414 | Transistor, 15850 | 15850 | |
| Q415 | Transistor, 3N83 | Q0193 | |
| Q416 | Transistor, 3N83 | Q0193 | |
| Q417 | Transistor, 3N83 | Q0193 | |
| Q418 | Transistor, 3N83 | Q0193 | |
| Q419 | Transistor, 15840 | 15840 | |
| Q420 | Transistor, 15840 | 15840 | |
| CR401 | NOT USED | | |
| CR402 | Diode, 6700 | 6700 | |
| CR403 | Diode, 6700 | 6700 | |
| CR404 | Diode, 6700 | 6700 | |
| CR405 | Diode, 6700 | 6700 | |
| CR406 | Diode, 6700 | 6700 | |
| CR407 | Diode, 6700 | 6700 | |
| CR408 | Diode, 6262 | CR0150 | |
| CR409 | Diode, 6700 | 6700 | |
| CR410 | Diode, 6700 | 6700 | |
| CR411 | Diode, 6700 | 6700 | |
| CR412 | Diode, 6700 | 6700 | |
| CR413 | Diode, 6700 | 6700 | |
| CR414 | Diode, 6700 | 6700 | |
| CR415 | Diode, 6700 | 6700 | |
| CR416 | Diode, 6700 | 6700 | |
| CR417 | Diode, 6700 | 6700 | |
| CR418 | Diode, 6700 | 6700 | |
| CR419 | Diode, 6700 | 6700 | |

| REFERENCE | DESCRIPTION | PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | NOT USED | | |
| R405 | NOT USED | | |
| R406 | NOT USED | | |
| R407 | NOT USED | | |
| R408 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R409 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R410 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R411 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R412 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R413 | NOT USED | | |
| R414 | NOT USED | | |
| R415 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R416 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R417 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R418 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R419 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R420 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R421 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R422 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R423 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R424 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R425 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R426 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R427 | Resistor, 4.7k, 5%, 1/4W, cc | R0892 | Allen Bradley CB4725 |
| R428 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R429 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R430 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R431 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R432 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R433 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R434 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R435 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R436 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R437 | NOT USED | | |
| R438 | NOT USED | | |
| R439 | Resistor, 27k, 5%, 1/4W, cc | R0924 | Allen Bradley CB2735 |
| R440 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R441 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R442 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R443 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R444 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR420 | Diode, 6700 | 6700 | |
| CR421 | Diode, 6700 | 6600 | |
| CR422 | Diode, 6700 | 6700 | |
| CR423 | Diode, 6700 | 6700 | |
| CR424 | NOT USED | | |
| CR425 | Diode, 6700 | 6700 | |
| CR426 | Diode, 6700 | 6700 | |
| CR427 | Diode, 6700 | 6700 | |
| CR428 | Diode, 6700 | 6700 | |
| CR429 | Diode, 6700 | 6700 | |
| CR430 | Diode, 6700 | 6700 | |
| CR431 | Diode, 6700 | 6700 | |
| CR432 | Diode, 6700 | 6700 | |
| CR433 | Diode, 6700 | 6700 | |
| C401 | NOT USED | | |
| C402 | NOT USED | | |
| C403 | NOT USED | | |
| C404 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C405 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C406 | Capacitor, 22 pF, 500V, mica | C0529 | |
| C407 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C408 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C409 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C410 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C411 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C412 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C413 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C414 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C415 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C416 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C417 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C418 | Capacitor, 33 pF, 500V, mica | C0531 | |
| C419 | NOT USED | | |
| C420 | Capacitor, .05 µF, 50V | C0708 | |
| C421 | Capacitor, .05 µF, 50V | C0708 | |
| C422 | Capacitor, .05 µF, 50V | C0708 | |
| C423 | Capacitor, .01 µF | C0705 | |
| C424 | Capacitor, .05 µF, 12V | C0672 | |
| R401 | NOT USED | | |
| R402 | NOT USED | | |
| R403 | NOT USED | | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R445 | Resistor, 3.3k, 5%, 1/2W, cc | R0136 | Allen Bradley EB3325 |
| R446 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R447 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R448 | NOT USED | | |
| R449 | NOT USED | | |
| R450 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R451 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R452 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R453 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R454 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R455 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R456 | Resistor, 5.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R457 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R458 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R459 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R460 | NOT USED | | |
| $461 | NOT USED | | |
| R462 | NOT USED | | |
| R463 | NOT USED | | |
| R464 | NOT USED | | |
| R465 | Resistor, 39k, 5%, 1/2W, cc | R0282 | Allen Bradley EB3935 |
| R466 | NOT USED | | |
| R467 | NOT USED | | |
| R468 | Resistor, 39k, 5%, 1/2W, cc | R0282 | Allen Bradley EB3935 |
| R469 | NOT USED | | |
| R470 | NOT USED | | |
| R471 | Resistor, 39k, 5%, 1/2W, cc | R0282 | Allen Bradley EB3935 |
| R472 | Resistor, NOT USED | | |
| R473 | Resistor, 39k, 5%, 1/2W, cc | R0282 | Allen Bradley EB3935 |
| R474 | Resistor, 6.8k, 5%, 1/2W, cc | R0514 | Allen Bradley EB6825 |
| R475 | Resistor, 120k, 2%, 1/2W | R1499 | |
| R476 | Resistor, 120k, 2%, 1/2W | R1499 | |
| R477 | Resistor, 100k, 2%, 1/2W | R1498 | |
| R478 | Resistor, 100k, 2%, 1/2W | R1498 | |
| R479 | Resistor, 22k, 2%, 1W | R1596 | |
| R480 | Resistor, 75k, 5%, 1/4W, cc | R0976 | Allen Bradley CB7535 |
| R481 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R482 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R483 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R484 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R485 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R486 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R487 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R488 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R489 | Resistor, 5.6k, 5%, 1/2W, cc | R0562 | Allen Bradley EB5625 |
| R490 | Resistor, 200 , 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R491 | NOT USED | | |
| R492 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R493 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R494 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R495 | NOT USED | | |
| R496 | NOT USED | | |
| R497 | NOT USED | | |
| R498 | NOT USED | | |
| R499 | Resistor, 47k, 5%, 1/2W, cc | R0144 | Allen Bradley EB4735 |
| R500 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R501 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R502 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R503 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | 2.5 MHz Decade P.C. Ass'y | 11527 | |
| Q500 | Transistor, 15840 | 15840 | |
| Q501 | Transistor, 15840 | 15840 | |
| Q502 | NOT USED | | |
| Q503 | NOT USED | | |
| Q504 | NOT USED | | |
| Q505 | Transistor, 14000 | 14000 | |
| Q506 | Transistor, 14000 | 14000 | |
| Q507 | Transistor, 14000 | 14000 | |
| Q508 | Transistor, 14000 | 14000 | |
| Q509 | Transistor, 14000 | 14000 | |
| Q510 | Transistor, 14000 | 14000 | |
| Q511 | Transistor, 14000 | 14000 | |
| Q512 | Transistor, 14000 | 14000 | |
| Q513 | Transistor, 14000 | 14000 | |
| Q514 | Transistor, 15850 | 15850 | |
| Q515 | Transistor, 3N83 | Q0193 | |
| Q516 | Transistor, 3N83 | Q0193 | |
| Q518 | Transistor, 3N83 | Q0193 | |
| Q519 | Transistor, 15840 | 15840 | |
| Q520 | Transistor, 15840 | 15840 | |
| Q521 | Transistor, 2N1306 | Q0075 | |
| CR500 | NOT USED | | |
| CR501 | NOT USED | | |
| CR502 | Diode, 6700 | 6700 | |
| CR503 | Diode, 6700 | 6700 | |
| CR504 | Diode, 6700 | 6700 | |
| CR505 | Diode, 6700 | 6700 | |
| CR506 | Diode, 6700 | 6700 | |
| CR507 | Diode, 6700 | 6700 | |
| CR508 | Diode, 6262 | CR0150 | |
| CR509 | Diode, 6700 | 6700 | |
| CR510 | Diode, 6700 | 6700 | |
| CR511 | Diode, 6700 | 6700 | |
| CR512 | Diode, 6700 | 6700 | |
| CR513 | Diode, 6262 | CR0150 | |
| CR514 | Diode, 6700 | 6700 | |
| CR515 | Diode, 6700 | 6700 | |
| CR516 | Diode, 6700 | 6700 | |
| CR517 | Diode, 6700 | 6700 | |
| CR518 | Diode, 6700 | 6700 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR519 | NOT USED | | |
| CR520 | Diode, 6700 | 6700 | |
| CR521 | Diode, 6700 | 6700 | |
| CR522 | Diode, 6700 | 6700 | |
| CR523 | Diode, 6700 | 6700 | |
| CR524 | NOT USED | | |
| CR525 | Diode, 6700 | 6700 | |
| CR526 | Diode, 6700 | 6700 | |
| CR527 | Diode, 6700 | 6700 | |
| CR528 | Diode, 6700 | 6700 | |
| CR529 | Diode, 6700 | 6700 | |
| CR530 | Diode, 6700 | 6700 | |
| CR531 | Diode, 6700 | 6700 | |
| CR532 | Diode, 6700 | 6700 | |
| CR533 | Diode, 6700 | 6700 | |
| | NOT USED | | |
| C501 | NOT USED | | |
| C502 | NOT USED | | |
| C503 | NOT USED | | |
| C504 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C505 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C506 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C507 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C508 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C509 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C510 | Capacitor, 100 pF, 500V, mica | C0536 | |
| C511 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C512 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C513 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C514 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C515 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C516 | Capacitor, 68 pF, 500V, mica | C0635 | |
| C517 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C518 | Capacitor, 47 pF, 500V, mica | C0533 | |
| C519 | NOT USED | | |
| C520 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C521 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C522 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C523 | Capacitor, .01 µF, 50V, mylar | C0705 | |
| C524 | NOT USED | | |
| C525 | Capacitor, .05 µF, 50V, disc | C0708 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| C526 | Capacitor, 180 pF, 500V, mica | C0643 | |
| C527 | Capacitor, .05 µF, 12V, disc | C0672 | |
| R500 | NOT USED | | |
| R501 | NOT USED | | |
| R502 | NOT USED | | |
| R503 | NOT USED | | |
| R504 | NOT USED | | |
| R505 | NOT USED | | |
| R506 | NOT USED | | |
| R507 | Resistor, 200Ω, 5%, 1/4W, cc | R0736 | Allen Bradley CB2015 |
| R508 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R509 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R510 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R511 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R512 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R513 | NOT USED | | |
| R514 | NOT USED | | |
| R515 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R516 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R517 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R518 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R519 | Resistor, 1.5k, 5%, 1/4W, cc | R0783 | Allen Bradley CB1525 |
| R520 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R521 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R522 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R523 | Resistor, 2.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R524 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R525 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R526 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R527 | NOT USED | | |
| R528 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R529 | NOT USED | | |
| R530 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R531 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R532 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R533 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R534 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R535 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R536 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R537 | NOT USED | | |
| R538 | NOT USED | | |

| REFERENCE | DESCRIPTION | SØ PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R539 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R540 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R541 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R542 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R543 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R544 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R545 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R546 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R547 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R548 | NOT USED | | |
| R549 | NOT USED | | |
| R550 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R551 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R552 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R553 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R554 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R555 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R556 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R557 | Resistor, 6.8k, 5%, 1/4W, cc | R0606 | Allen Bradley CB6825 |
| R558 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R559 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R560 | NOT USED | | |
| $561 | NOT USED | | |
| R562 | NOT USED | | |
| R563 | NOT USED | | |
| R564 | NOT USED | | |
| R565 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R566 | NOT USED | | |
| R567 | NOT USED | | |
| R568 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R569 | NOT USED | | |
| R570 | NOT USED | | |
| R571 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R572 | NOT USED | | |
| R573 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R574 | Resistor, 6.8k, 5%, 1/4W, cc | R0606 | Allen Bradley CB6825 |
| R575 | Resistor, 120k, 2%, 1/2W, cc | R1499 | |
| R576 | Resistor, 120k, 2%, 1/2W, cc | R1499 | |
| R577 | Resistor, 100k, 2%, 1/2W, | R1498 | |
| R578 | Resistor, 100k, 2%, 1/2W, | R1498 | |
| R579 | Resistor, 22k, 2%, 1W | R1596 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R580 | Resistor, 75k, 5%, 1/4W, cc | R0976 | Allen Bradley CB7535 |
| R581 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R582 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R583 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R584 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R585 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R586 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R587 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R588 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R589 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB6525 |
| R590 | NOT USED | | |
| R591 | NOT USED | | |
| R592 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R593 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R594 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R595 | Resistor, 8.2k, 5%, 1/4W, cc | R0883 | Allen Bradley CB8225 |
| R596 | NOT USED | | |
| R597 | NOT USED | | |
| R598 | Resistor, 470Ω, 5%, 1/4W, cc | R1044 | Allen Bradley CB4715 |
| R599 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R600 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R601 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R602 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R603 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R604 | Resistor, 120k, 5%, 1/4W, cc | R0807 | Allen Bradley CB1245 |

## 250 kHz DECADE

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| | 250 kHz Decade P.C. Ass'y | 11523 | |
| Q600 | Transistor, 51840 | 15840 | |
| Q601 | Transistor, 15840 | 15840 | |
| Q602 | Transistor, 6727 | 6727 | |
| Q603 | Transistor, 6727 | 6727 | |
| Q604 | Transistor, 6727 | 6727 | |
| Q605 | Transistor, 6727 | 6727 | |
| Q606 | Transistor, 6727 | 6727 | |
| Q607 | Transistor, 6727 | 6727 | |
| Q608 | Transistor, 6727 | 6727 | |
| Q609 | Transistor, 6727 | 6727 | |
| Q610 | Transistor, 15850 | 15850 | |
| Q511 | Transistor, 3N83 | Q0193 | |
| Q612 | Transistor, 3N83 | Q0193 | |
| Q613 | Transistor, 3N83 | Q0193 | |
| Q614 | Transistor, 3N83 | Q0193 | |
| Q615 | Transistor, 15840 | 15840 | |
| Q616 | Transistor, 15840 | 18540 | |
| CR600 | Diode, 6700 | 6700 | |
| CR601 | Diode, 6700 | 6700 | |
| CR602 | Diode, 6700 | 6700 | |
| CR603 | Diode, 6700 | 6700 | |
| CR604 | Diode, 6700 | 6700 | |
| CR605 | Diode, 6700 | 6700 | |
| CR606 | Diode, 6700 | 6700 | |
| CR607 | Diode, 6700 | 6700 | |
| CR608 | Diode, 6700 | 6700 | |
| CR609 | Diode, 6700 | 6700 | |
| CR610 | Diode, 6700 | 6700 | |
| CR611 | Diode, 6700 | 6700 | |
| CR612 | Diode, 6700 | 6700 | |
| CR613 | Diode, 6700 | 6700 | |
| CR614 | Diode, 6700 | 6700 | |
| CR615 | Diode, 6700 | 6700 | |
| CR616 | Diode, 6700 | 6700 | |
| CR617 | Diode, 6700 | 6700 | |
| CR618 | Diode, 6700 | 6700 | |
| CR619 | Diode, 6700 | 6700 | |
| CR620 | Diode, 6700 | 6700 | |
| CR621 | Diode, 6700 | 6700 | |
| CR622 | Diode, 6700 | 6700 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| CR623 | Diode, 6700 | 6700 | |
| CR624 | Diode, 6700 | 6700 | |
| CR625 | Diode, 6700 | 6700 | |
| C600 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C601 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C602 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C603 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C604 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C605 | Capacitor, 680 pF, 500V, mica | C0638 | |
| C606 | Capacitor, 680 pF, 500V, mica | C0638 | |
| C607 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C608 | Capacitor 390 pF, 500V, mica | C0541 | |
| C609 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C610 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C611 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C612 | Capacitor, 390 pF, 500V, mica | C0541 | |
| C613 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C614 | Capacitor, 220 pF, 500V, mica | C0538 | |
| C615 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C616 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C617 | Capacitor, .05 µF, 50V, disc | C0708 | |
| C618 | Capacitor, .01 µF, 50V, mylar | C0705 | |
| R600 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R601 | Resistor, 15k, 5%, 1/4W, cc | R0728 | Allen Bradley CB1535 |
| R602 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R603 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R604 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R605 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R606 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R607 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R608 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R609 | Resistor, 27k, 5%, 1/4W, cc | R0824 | Allen Bradley CB2735 |
| R610 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R611 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R612 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R613 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R514 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R515 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R516 | Resistor, 100k, 5%, 1/4W, cc | R0471 | Allen Bradley CB1045 |
| R517 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R518 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R619 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R620 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R621 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R622 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R623 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R624 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R625 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R626 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R627 | Resistor, 3.3k, 5%, 1/4W, cc | R0742 | Allen Bradley CB3325 |
| R628 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R629 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R630 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R631 | Resistor, 7.5k, 5%, 1/4W, cc | R0884 | Allen Bradley CB7525 |
| R632 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R633 | Resistor, 100k, 5%, 1/4W, cc | R0741 | Allen Bradley CB1045 |
| R634 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R635 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R636 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R637 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R638 | Resistor, 200k, 5%, 1/4W, cc | R0823 | Allen Bradley CB2045 |
| R639 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R640 | Resistor, 30k, 5%, 1/4W, cc | R0715 | Allen Bradley CB3035 |
| R641 | Resistor, 100k, 2%, 1/2W | R1498 | |
| R642 | Resistor, 100k, 2%, 1/2W, | R1498 | |
| R643 | NOT USED | | |
| R644 | NOT USED | | |
| R645 | NOT USED | | |
| R646 | NOT USED | | |
| R647 | NOT USED | | |
| R648 | NOT USED | | |
| R649 | NOT USED | | |
| R650 | NOT USED | | |
| R651 | NOT USED | | |
| R652 | NOT USED | | |
| R653 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R654 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R655 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R656 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R657 | Resistor, 39k, 5%, 1/4W, cc | R0748 | Allen Bradley CB3935 |
| R658 | Resistor, 120k, 2%, 1/2W, | R1499 | |
| R659 | Resistor, 120k, 2%, 1/2W | R1499 | |

| REFERENCE | DESCRIPTION | SD PART NO. | MANUFACTURERS PART NO. |
|---|---|---|---|
| R660 | Resistor, 22k, 2%, 1W | R1596 | |
| R661 | Resistor, 75k, 5%, 1/4W, cc | R0976 | Allen Bradley CB7535 |
| R662 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R663 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R664 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R665 | Resistor, 5.6k, 5%, 1/4W, cc | R0821 | Allen Bradley CB5625 |
| R666 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R667 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R668 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R669 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R670 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R671 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R672 | Resistor, 1 Meg, 5%, 1/4W, cc | R0962 | Allen Bradley CB1055 |
| R673 | Resistor, 3.9k, 5%, 1/2W, cc | R0616 | Allen Bradley EB3925 |
| R674 | Resistor, 47k, 5%, 1/4W, cc | R0777 | Allen Bradley CB4735 |
| R675 | Resistor, 20k, 5%, 1/4W, cc | R0964 | Allen Bradley CB2035 |
| R676 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |
| R678 | Resistor, 6.8k, 5%, 1/4W, cc | R0696 | Allen Bradley CB6825 |

# FINAL ASSEMBLY 1037

| REFERENCE | DESCRIPTION | SD PART NO. | QTY. |
|---|---|---|---|
| | Model 1037 Block Diagram | D15452 | |
| | Universal Chassis Assembly | D23355 | 1 |
| | Power Supply Storage Assembly | D19681 | 1 |
| | 250 kHz Storage Decade Assembly | D11523 | 1 |
| | 2.5 MHz Storage Decade Assembly | D11527 | 1 |
| | 10 MHz Storage Decade Assembly | D15200 | 1 |
| | 50 MHz Storage Decade Assembly | D12979 | 1 |
| | Display and Reset Assembly | D19243 | 1 |
| | Multiplier Assembly | D17966 | 1 |
| | 50 MHz Amplifier | D13534 | 1 |
| | Time Base Assembly | D15422 | 1 |
| | Range Switch Level Control Cable Assembly | B15718 | 1 |
| | Time Base, Function Switch Assembly | D23584 | 1 |
| | Bottom Cover Assembly | C17345 | 1 |
| C2 | Capacitor, 1 µF, 600 V | C0801 | 1 |
| C10 | Capacitor, .05 µF, 50 V, Disc. | C0708 | 1 |
| CR1 | Diode, Zener | 19330 | 1 |
| CR2 | Diode, Zener | 19330 | 1 |
| I1 | Lamp, Pilot (red) | I0075 | 1 |
| I100 | Lamp, Pilot (amber) | I0076 | 1 |
| J8 | Connector, BNC | J0260 | 1 |
| R5 | Resistor, 6.8 k, 1/4 W, 5% | R0696 | 1 |
| R6 | Resistor, 6.8 k, 1/4 W, 5% | R0696 | 1 |
| V1 | Indicator, Readout | V0150 | 1 |
| V2 | Indicator, Readout | V0150 | 1 |
| V3 | Indicator, Readout | V0150 | 1 |
| V4 | Indicator, Readout | V0150 | 1 |
| V5 | Indicator, Readout | V0150 | 1 |
| V6 | Indicator, Readout | V0150 | 1 |
| V7 | Indicator, Readout | V0150 | 1 |
| V8 | Indicator, Readout | V0150 | 1 |

## FINAL ASSEMBLY 1037 (con't.)

| REFERENCE | DESCRIPTION | SD PART NO. | QTY. |
|---|---|---|---|
| Y101 | Oscillator | Y0023 | 1 |
| | Bar Cover Retainer | 17090 | 2 |
| | Ground Lug, BNC | E0137 | 1 |
| | Handle | H0947 | 2 |
| | Knob, Concentric, Upper 1/8 Shaft | H1297 | 1 |
| | Knob, Round, 1/4 Dia Shaft | H1301 | 1 |
| | Knob, Round, 1/8 Dia Shaft | H1298 | 1 |
| | Knob, Concentric, Lower 1/4 Shaft | H1300 | 1 |
| | Knob, Dial Skirted, 1/4 Shaft | H1299 | 1 |
| | Retainer Cover | 17216 | 2 |
| | Terminal, Feed Thru | E0015 | 1 |
| | Trim Strip | 17088-1 | 2 |
| | Front Panel Assembly | D15439 | |
| J2 | Connector, BNC | J0260 | 1 |
| S7 | Switch, Toggle, DPDT | S0073 | 1 |
| | Switch, Pushbutton, SPST | S0140 | 1 |
| | Ground Lug, BNC | E0137 | 1 |
| | Input Cable | 10338 | 1 |
| | Lock, Panel | 11342 | 1 |
| | Panel Adapter | 17125 | 2 |
| | Rack Mounting Kit | 17350 | 1 |
| | Retainer Window | 17092 | 2 |
| | Spec. Panel Name Plate Foil | 17292 | 1 |
| | Trim Strip | 17088-2 | 2 |
| | Window | 11066 | 1 |

# "B" OPTION

The "B" Option provides the SD 1000 Series with a high stability oscillator. The "B" Oscillator, unlike the standard 1 MHz oscillator, has an output frequency of 3 MHz. A divide-by-three circuit has been added to convert the oscillator's output frequency to the required 1 MHz reference frequency.

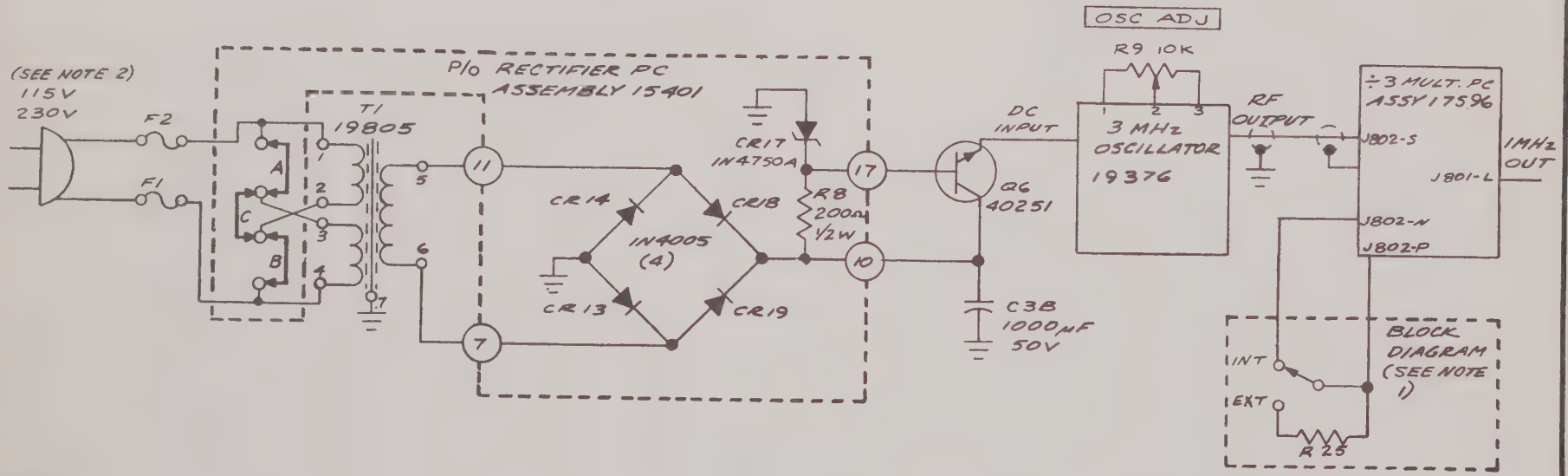
The "B" Option comprises the "B" Oscillator, a separate power supply, and the Divide-By-Three Multiplier circuit (refer to "B" Option Schematic 15470). The improved specifications for the "B" Oscillator Option are listed below.

## B HIGH-STABILITY OSCILLATOR

1. **Aging rate:** 1 part in $10^9$/24 hrs.
2. **Warm-up time to reach specified aging rate:** 30 hrs.
3. **Aging rate after 60 days continuous operation:** 3 parts in $10^{10}$/24 hrs.
4. **Accuracy 1 hour after turn-on referenced to previous turn-off:** 5 parts in $10^9$ absolute from turn-off frequency.
5. **Short-term stability averaged over 1 second:** 1 part in $10^{10}$ rms.
6. **Long-term aging rate:** 3 parts in $10^8$/30 days.
7. **Variation with temperature (average ±2 parts in $10^{10}$/°C):** -20°C to +25°C: ±9 parts in $10^9$, +25°C to +55°C: ±6 parts in $10^9$.
8. **Vibration (5-55 Hz, 0.016" DA):** ±2 parts in $10^8$ (MIL-STD-167).
9. **Shock (50 G, 11 ms):** ±1 part in $10^8$ (MIL STD-202A).
10. **±10% change in line voltage:** ±5 parts in $10^{10}$.
11. **Storage temperature:** -65°C to +85°C.

Although the "B" Oscillator is a sealed unit, two frequency adjustments are provided: COURSE adjust (variable capacitor slot adjustable on oscillator module-access through plug-in cavity) and a fine OSC ADJ (rear panel mounted variable resistor).

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO. | ECO NO. | DATE | APP. BY |
| C | REDRAWN PER ECO | | 5716 | 3/19/68 | RB |
| D | ADDED R9 | ~ | 5779 | 9-30-68 | RB |




NOTE-

1) BLOCK DIAGRAM REF
   1037 - 15672
   1034 - 17008
   1017 - 19221
   1038 - 19237
   1018 - 19236

2) FOR 115v USE JUMPERS A & B.
   FOR 230v USE JUMPER C.

| ITEM NO. | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO. |
|---|---|---|---|---|
| | | | | |

LIST OF MATERIALS

| USED ON | NEXT ASSY |
|---|---|
| 1018 B | 19520 |
| 1038 B | 19516 |
| 1017 B | 19304 |
| 1034 B | 17017 |
| 1037 B | 17010 |

APPLICATION

DRAWN JENNINGS 1-9-68 DATE
CHECK RB 4-10-68 DATE
ELECT. 4-10-68 DATE
MECH RB 4-10-68 DATE
PROJ. 4-10-68 DATE
APPROVAL 4-10-68 DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
.X
.XX
.XXX
ANGLES ±

SCALE ~ DO NOT SCALE DRAWING

DWG SIZE B
SH 1 OF 1

SYSTRON DONNER
CORPORATION
CONCORD, CALIFORNIA

MATERIAL ~

SCHEMATIC
B OPTION

DWG NO. 15470

ISSUE D

# "B3" OPTION

The "B3" Option provides the SD 1000 Series with a medium stability oscillator. The "B3" Oscillator, unlike the standard 1 MHz oscillator, has an output frequency of 3 MHz. A divide-by-three circuit has been added to convert the oscillator's output frequency to the required 1 MHz reference frequency.

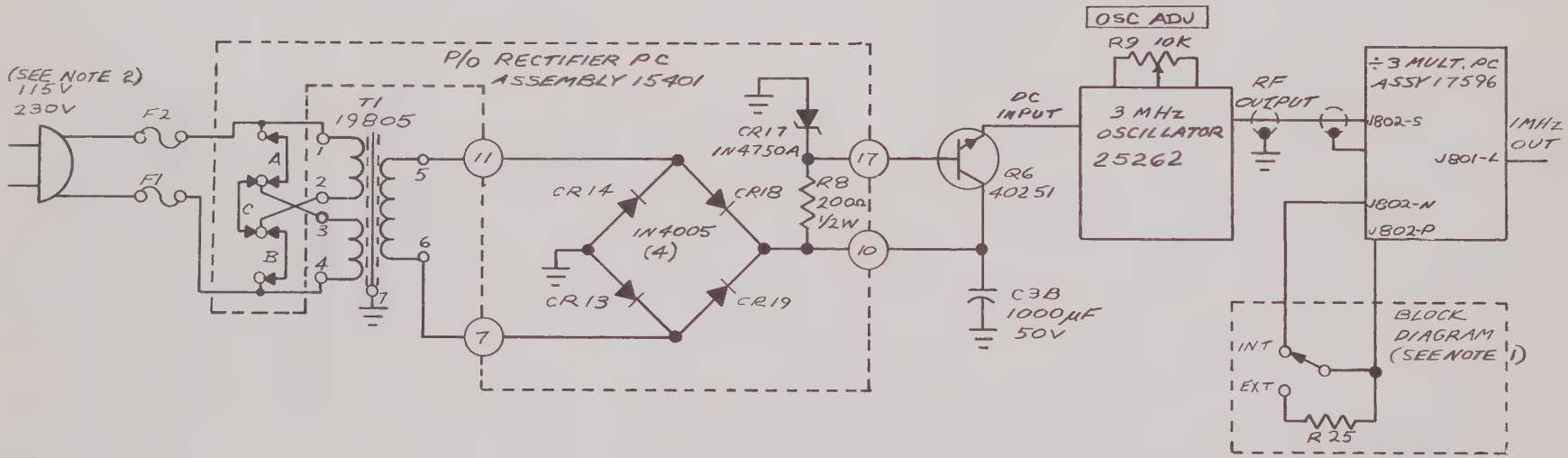
The "B3" Option comprises the "B3" Oscillator, a separate power supply, and the Divide-BY-Three Multiplier circuit (refer to "B3" Option Schematic 15847). The improved specifications for the "B3" Oscillator Option are listed below.

## $B_3$ MEDIUM-STABILITY OSCILLATOR

1. **Aging rate:** 3 parts in $10^9$/24 hrs.
2. **Warm-up time to reach specified aging rate:** 72 hrs.
3. **Aging rate after 60 days continuous operation:** <3 parts in $10^9$/24 hrs.
4. **Short-term stability averaged over 1 second:** 2 parts in $10^{10}$ rms.
5. **Long-term aging rate:** 2 parts in $10^8$/7 days.
6. **Variation with temperature (average ±2 parts in $10^{10}$/°C):** -20°C to +25°C: ±9 parts in $10^9$, ±25°C to 55°C: ±6 parts in $10^9$.
7. **±10% change in line voltage:** ±5 parts in $10^{10}$.

Should oscillator adjustment be deemed necessary *, set the OSC ADJ resistor to mid-range prior to readjusting the COURSE adjust. Since the oscillator's output frequency may vary with temperature, DO NOT attempt to adjust the oscillator with the covers removed.

* *Allow for a minimum of 30 hours of continuous operation prior to adjusting the oscillator.*




NOTE-

1) BLOCK DIAGRAM REF.
   1037 - 15672
   1034 - 17008
   1017 - 19221
   1038 - 19237
   1018 - 19236

2) FOR 115V USE JUMPERS A & B.
   FOR 230V USE JUMPER C.

SCHEMATIC
B3 OPTION

15847 D

| | |
|---|---|
| 1018 | 19225 |
| 1038 | 19226 |
| 1017 B3 | 19305 |
| 1034 B3 | 17061 |
| 1037 B3 | 17062 |
| USED ON | NEXT ASSY |

# "B4" OPTION

The "B4" Option provides the SD 1000 Series with a super high-stability oscillator. The "B4" oscillator, unlike the standard 1MHz oscillator, has an output frequency of 3MHz. A divide-by-three circuit has been added to convert the oscillator's output frequency to the required 1MHz reference frequency.

The "B4" Option comprises the "B4" Oscillator, a separate power supply and regulator circuit and the Divide-By-Three Multiplier circuit (refer to "B4" Option Schematic 27096). The improved specifications for the "B4" Oscillator Option are listed below:

1) Frequency Output: 3MHz.
2) Stability:

   Temperature -- Less than 5 parts in $10^{11}$/°C from 0 to +50°C.

   Aging Rate -- Less than 5 parts in $10^{10}$/24 hours, after warm-up.*

   Line Voltage -- Less than 1 part in $10^{10}$ for a 10% voltage change.

   Short Term -- 5 parts in $10^{11}$rms (averaged for 1 second).

   Frequency Retrace -- After approximately 24 hours of shut-down, one hour (typical) is required to reach within 5 parts in $10^{9}$ of the frequency that existed prior to when equipment turn-off.
3) Frequency Adjust:

   Range (Coarse) -- ±2 parts in $10^{6}$.

   Range (Fine) -- ±4 parts in $10^{8}$.

   Resolution -- ±1 part in $10^{10}$.

**Up to 72 hours may be required to reach this aging rate after lengthly "no power applied" periods of time.*

Although the "B4" Oscillator is a sealed unit, two frequency adjustments are provided: COARSE adjust (variable capacitor slot adjustable on oscillator module - access through plug-in

cavity) and a fine OSC ADJ (rear panel mounted variable resistor). Should oscillator adjustment be deemed necessary**, set the OSC ADJ resistor (rear panel) to mid-range prior to readjusting the COARSE adjust. Since the oscillator's output frequency may vary with temperature, DO NOT attempt to adjust the oscillator with the covers removed.

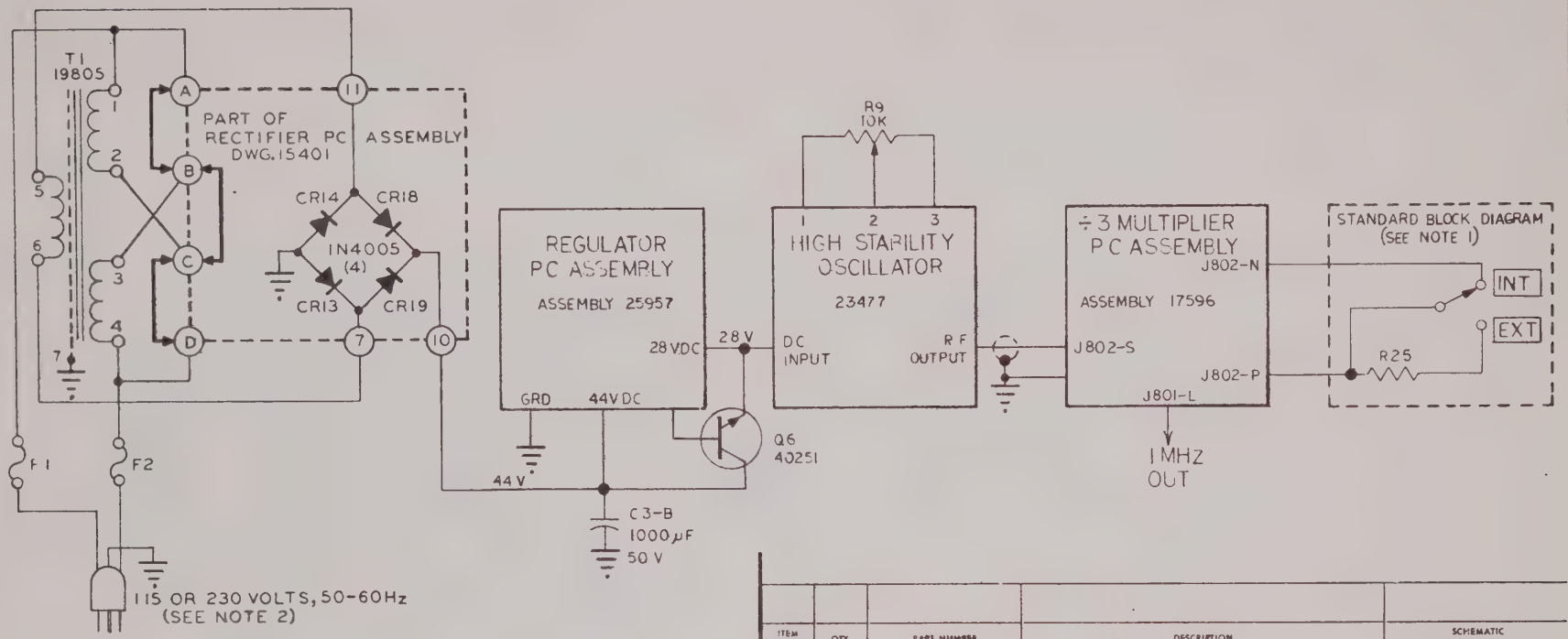
***Allow for a minimum of 72 hours of continuous operation prior to adjusting the oscillator.*

## POWER SUPPLY AND REGULATOR

The "B4" oscillator's power requirements are supplied by an additional power supply and regulator circuit. The regulator requires +44V dc which it in-turn regulates to +28V dc, the required voltage for operation of the oscillator. The output (secondary) from transformer T1 (see Schematic 27096) is applied to a fullwave bridge rectifier (CR13, 14, 18 and 19) and filtered by capacitor C3-B to +44V dc.

The +44V potential is introduced to a regulatory circuit (Schematic 25960) consisting of Q1, Q2, Q3, Q6 and their associated circuitry. Q1, is th regulator's constant current source. The forward bias on Q1 remains constant as zener diode CR1 maintains a fixed difference of potential between the base and emitter for any deviation within the 44 volt supply. Q6, Q2, and Q3 are the series regulator transistors. Q6 is in the emitter follower configuration with Q2 for high current gain. Q3 acts as the control for the regulator. Biased by CR3, an increase in the output voltage will increase the forward bias on Q3 which, in turn, decreases the drive to the base of Q2 offsetting the initial increase in voltage. Similarly, any decrease in the output voltage will decrease the drive of Q3, hence increasing the drive on Q2 nullifying the decrease in voltage at the output.

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO. | ECO NO. | DATE | APP. BY |
| A | RELEASED FROM XP 2 TO RECORDS | ~ | ~ | 9/20/68 | |




NOTE:

1. BLOCK DIAGRAM REFERENCES
   1017-19221 1018-19236
   1037-15672 1038-19237
   1034-17008
2. FOR 115v USE JUMPERS A-B & C-D.
   FOR 230v USE JUMPER B-C.

| ITEM NO. | QTY | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO. |
|---|---|---|---|---|

LIST OF MATERIALS

| USED ON | NEXT ASSY |
|---|---|
| 1018 B4 | 23674 |
| 1038 B4 | 23677 |
| 1034 B4 | 23675 |
| 1037 B4 | 23676 |
| 1017 B4 | 23673 |
| APPLICATION | |

DRAWN JENNING 9-20-68 DATE
CHECK 10-18-68 DATE
ELECT. DATE
MECH. 10-18-68 DATE
PROJ. DATE
APPROVAL 10-DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
.X
.XX ~
.XXX
ANGLES ±

SCALE ~ DO NOT SCALE DRAWING DWG SIZE B SH 1 OF 1

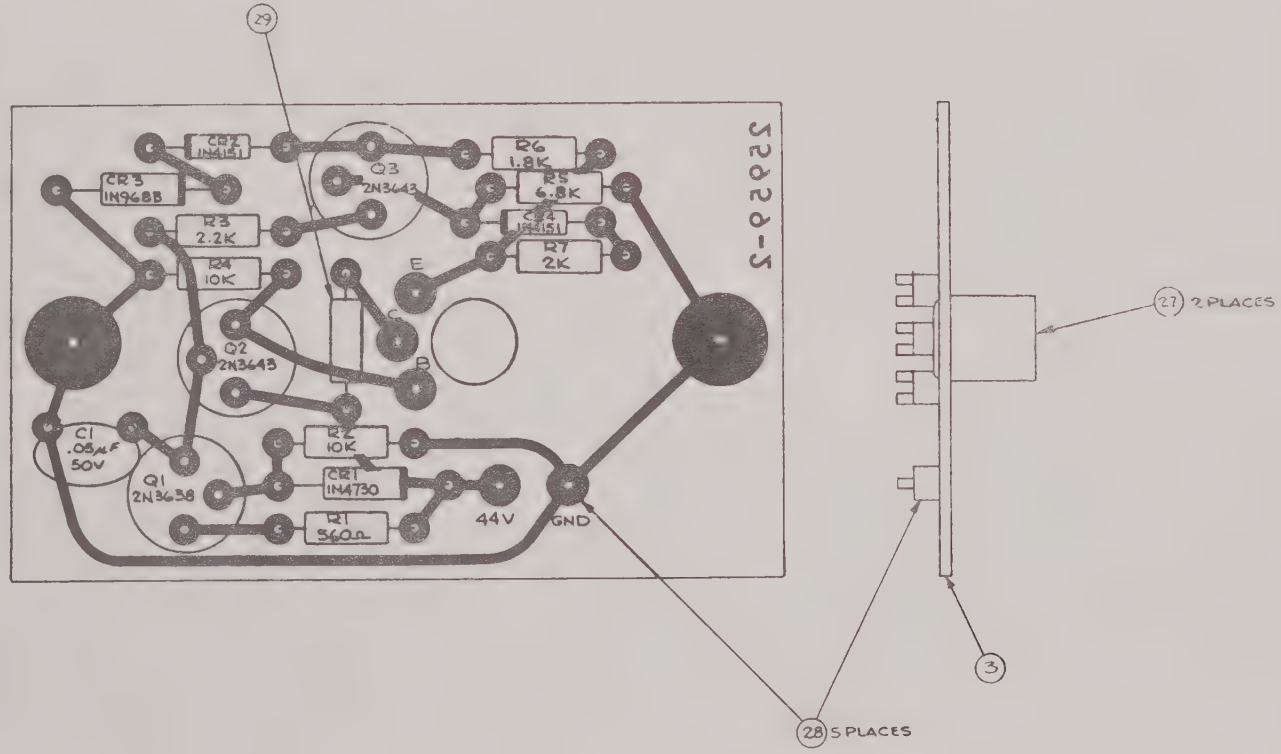
SYSTRON DONNER CORPORATION
CONCORD, CALIFORNIA

MATERIAL ~

SCHEMATIC
B4 OPTION

DWG NO. 27096 ISSUE A

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ZONE | DESCRIPTION | ENG. ORD. | E. C. NO. | DATE | APP. BY |
| | | | | | |




NOTE:
UNLESS NOTED: ALL RES ARE ¼W, 5%

| ITEM NO. | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO |
|---|---|---|---|---|

LIST OF MATERIALS

PROPRIETARY DATA

Furnished under United States Government Contract No. _____
Shall not be either released outside the Government, or used, duplicated, or disclosed in whole or in part for manufacture or procurement, without the written permission of Systron-Donner Corporation except for: (1) emergency repair or overhaul work by or for the Government, where the item or process concerned is not otherwise reasonably available to enable timely performance of the work; or (2) release to a foreign government, as the interests of the United States may require; provided that in either case the release, use, duplication or disclosure hereof shall be subject to the foregoing limitations. This legend shall be marked on any reproduction hereof in whole or in part.

| | |
|---|---|
| 7000 B4 | SERIES |
| 6000 B4 | SERIES |
| 1000 B4 | SERIES |
| USED ON | NEXT ASSY |
| APPLICATION | |

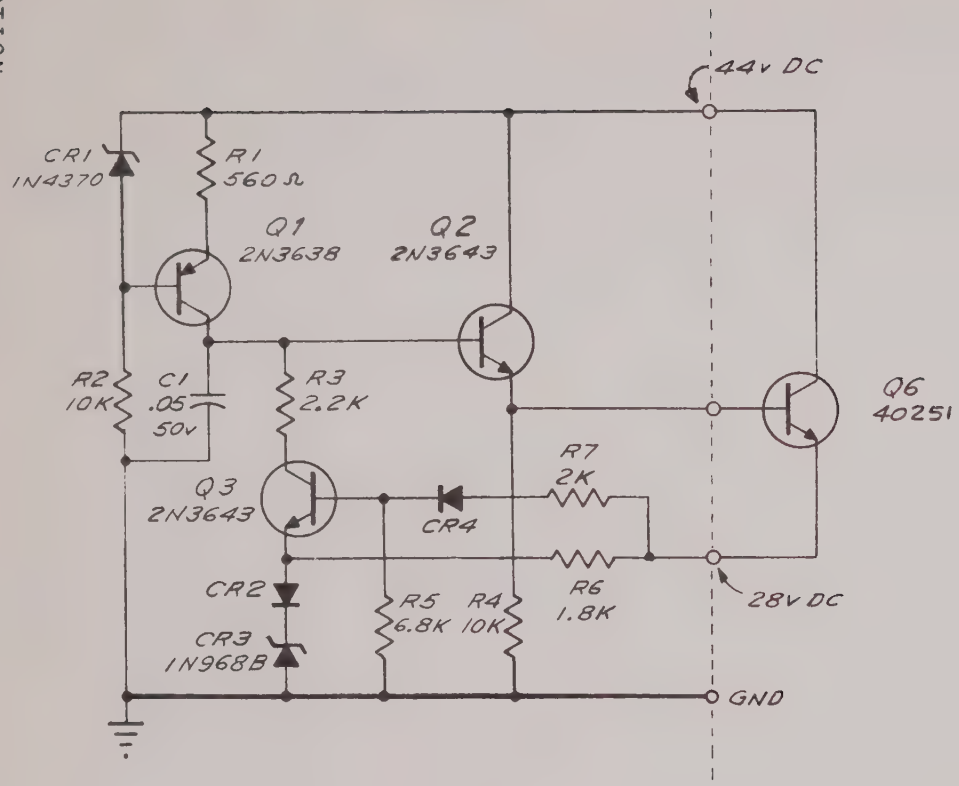
| | | | |
|---|---|---|---|
| DRAWN | B. MILLER 6-1-72 | DATE | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE .X ± — .XX ± — .XXX ± — ANGLES ± — |
| CHECK | DB 6-11-72 | DATE | |
| ELECT. | | DATE | |
| MECH. | | DATE | |
| PROJECT | | DATE | |
| APPROVAL | | DATE | |
| SCALE | 4:1 | DO NOT SCALE DRAWING | DWG SIZE C SH 1 OF 1 |

SYSTRON DONNER CORPORATION
CONCORD, CALIFORNIA

MATERIAL —

P.C. ASSY, REGULATED SUPPLY B4 OPTION

DWG NO. 25957 ISSUE XP1




NOTE: EXCEPT AS NOTED.

1) RESISTORS:
POWER — 1/4 W.
TOL — 5%.

2) CAPACITOR VALUE IN μF.

3) DIODES ARE IN4151.

## LIST OF MATERIALS

| | |
|---|---|
| 7000 B4 | 25957 |
| 1000 B4 | 25957 |
| USED ON | NEXT ASSY |
| APPLICATION | |

DRAWN JN 6-5-68 DATE
CHECK RB 10-15-68 DATE
ELECT. DATE
MECH: RB 10-15-68 DATE
PROJECT DATE
APPROVAL DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
X
.XX —
.XXX
ANGLES ±

SCALE NONE | DO NOT SCALE DRAWING | DWG SIZE B | SH 1 OF 1

SYSTRON DONNER
CORPORATION
CONCORD, CALIFORNIA

MATERIAL —

SCHEMATIC, B4 REGULATOR P.C. ASSY.

DWG NO. 25960 | ISSUE A

# DIVIDE-BY-THREE MULTIPLIER
(Refer to Drawing 17597)

This assembly divides the 3 MHz output of the high stability oscillator by three to produce the 1 MHz reference frequency used in the counter. In addition, the board contains a 1 MHz shaper, 10 MHz multiplier and an electronic switch circuit.

## DIVIDE BY THREE CIRCUIT

The 3 MHz signal is applied to J802S and amplified by Q1. Q1's output is applied to Q2 which, with Q3, froms a Schmitt trigger. The output of the Schmitt trigger is applied to the divide by three circuit.

The divide by three circuit consists of two Flip-flop circuits (Q4-Q5 and Q6-Q7). The first has dual input gating and divides the 3 MHz input by two. The second has separate inputs: a 3 MHz input and the output of the first flip-flop. The 3 MHz input coupled to Q6 turns that transistor on, the next two pulses have no effect as the transistor is already turned on. At the third pulse the Q4-Q5 Flip-flop switches and turns Q7 on, which in turn turns Q6 off. The next 3 MHz pulse turns Q6 on again and the cycle repeats. The net effect is that one output pulse (at the collector of Q7) occurs for every three input pulses.

The output pulse, now 1 MHz, is applied to Q8, an amplifier. The output of Q8 is routed to J802-N, thru the INT/EXT switch (rear panel) and introduced into the Multiplier circuit (J802P) when in the INT position.

## MULTIPLIER CIRCUIT

The divided by three 1 MHz signal via the INT/EXT switch, is applied to the base of Q9. Q9, Q10 and Q11 amplify the 1 MHz signal and the output from Q11 is capacitively coupled to the base of Q12, the first stage of the multiplier. C16 and L1 form an LC tank circuit which is tuned by vari-

able inductor L1 to 5 MHz. The 5 MHz signal is then inductively coupled into L2 which, with L3, is tuned to 10 MHz. An output is taken from the junction of C21 and C22. This output is available at P800-1, via C32, for use in the counter in the test and count functions. This 10 MHz signal is also applied to the base of Q17 for use as a 0.1 μs time base. A second output is taken from L4 (P800 C and D) for use in the plug-in units. This output is tuned by L4 for maximum amplitude.

TIME BASE SELECT CIRCUIT

The selector circuit determines which time base is available for use as a start-stop signal and as a front panel output. The circuit is basically composed of two amplifiers and an electronic switch.

Q14 amplifies the selected time base and applies it to the base of Q15 which is the normally closed side of the switch. Q17 amplifies the 10 MHz output and applies it to Q16, the normally open side of the switch.

Switch (Q15 and Q16) operation is controlled by the voltage, or lack of voltage, at P800-J. In all positions of the time base switch (S1 wafer H) except $10^{-7}$ (10 MHz) there is no voltage applied to P800-J. Under these conditions Q15 is free to conduct and passes the time base signal to P800-A. At the same time Q16 is prevented from conducting by the positive bias applied to its base by Q18. Q18 is turned on by its fixed bias and will remain so until turned off by a positive voltage applied to P800-J. When the time base switch is placed in the $10^{-7}$ position, +30 volts is applied to P800-J. The +30 volts will turn Q18 off which, in turn, will allow Q16 to conduct and pass the 10 MHz signal to J800-A. At the same time the +30 volts is applied to the base of Q15-turning it off and preventing the time base (from Q14) from passing through the switch.

## MULTIPLIER ADJUSTMENT PROCEDURE

The only test equipment required for this procedure is an oscilloscope with a bandwidth of 10 MHz or greater.

*NOTE*

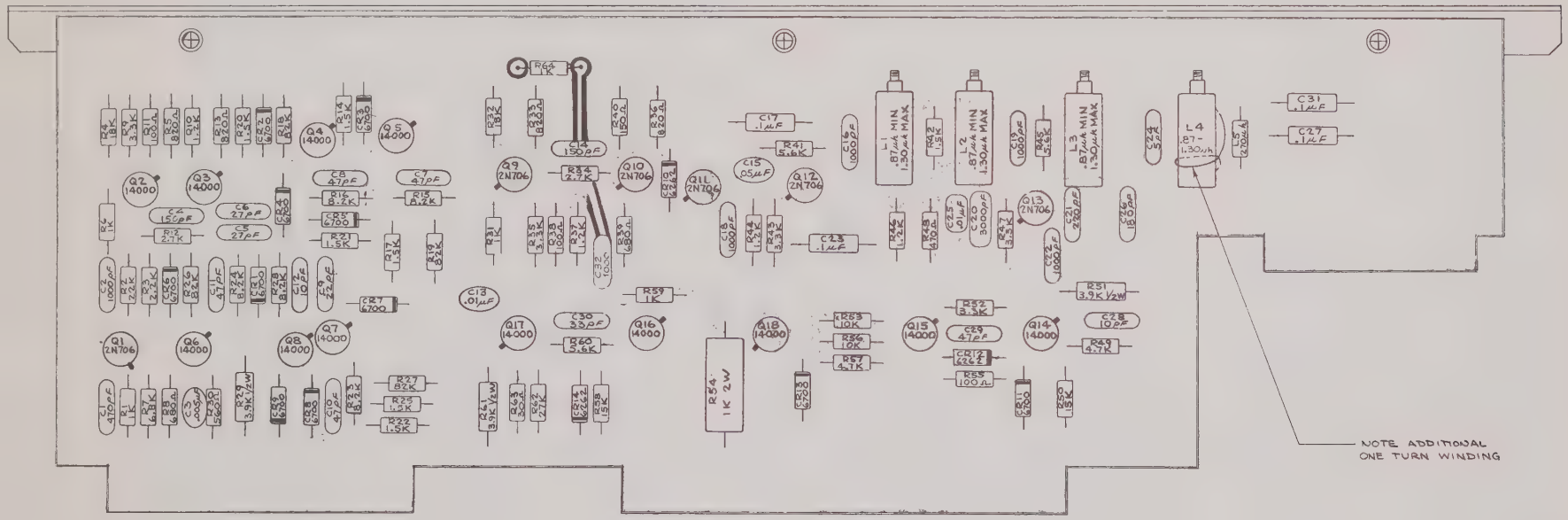
*A non-conductive tool must be used for this adjustment. Systron-Donner part number E-0188 (Delevan Electronics No. No. PC9668) or its equivalent is recommended for this procedure.*

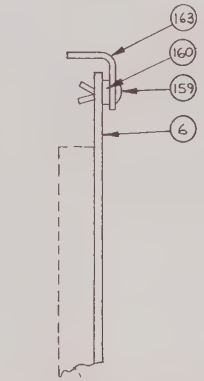
1) Connect the oscilloscope probe to the collector of Q12. (The collector is common to the transistor case). Adjust L1 for the maximum 5 MHz signal obtainable.
2) Place the oscilloscope probe on the collector of Q13, Adjust L2 for the maximum 10 MHz signal obtainable. Without removing the scope probe, adjust L3 for the maximum 10 MHz signal obtainable. Readjust both L2 and L3 alternately until the maximum possible 10 MHz signal is attained. 10 volts peak-to-peak (minimum should be seen at this point.
3) Place the oscilloscope probe at P800-D. Adjust L4 for maximum output. 3 volts peak-to-peak should be attainable.
4) Place the oscilloscope probe on P800-1 and readjust L1, L2, and L3 for maximum amplitude and minimum distortion.

*NOTE*

*Amplitude variations between successive cycles of the 10 MHz waveform may be observed. These are normal and will not affect proper operation of the counter.*

MULT ÷3 | 17596 | 10MC | 10MC | 5MC | 5MC

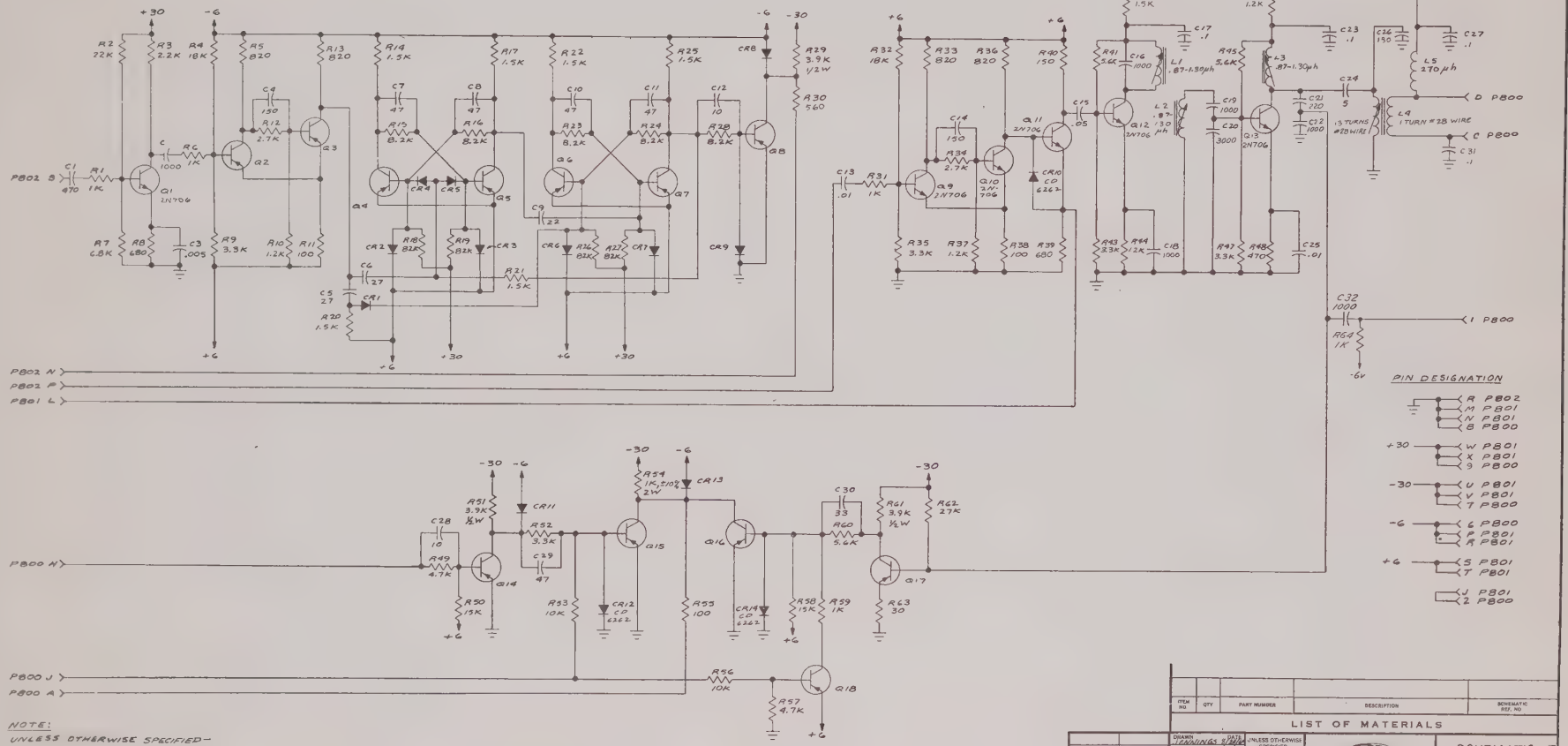



MTG DETAIL OF P.C. BOARD TO STIFFENER

NOTE: (EXCEPT AS NOTED)
1. RESISTORS ¼W, 5%
2. REF:
SCHEMATIC - 17597
PARTS LIST - P/L17596

| | | |
|---|---|---|
| | | DRAWN B.MILLER |
| | | CHECK |
| | | ELECT |
| 1017B | 19304 | MECH |
| 1037B | 17010 | PROJECT |
| 1034B | 17017 | APPROVAL |
| USED ON | NEXT ASSY | SCALE 2:1 |
| APPLICATION | | |




NOTE:
UNLESS OTHERWISE SPECIFIED—
1. ALL TRANSISTORS ARE 19-14000.
2. ALL DIODES ARE C-6700.
3. ALL RESISTORS ARE ±5%, 1/4W, VALUES IN Ω.
4. ALL CAPACITORS ARE ±10%, 50 V MIN.
5. CAPACITOR VALUES > 1.0 TO BE pf, < 1.0 TO BE μf.

REVISIONS

| ISSUE | DESCRIPTION | SER. NO. | ECO NO. | DATE | APP. BY |
|---|---|---|---|---|---|
| XP2 | ADDED C31; R30 WAS 1K, R39 WAS 1.2K, R42 WAS 330 R46 WAS 330, C21 WAS 330, C23 WAS 100, C24 WAS 5, C26 WAS 180 | — | — | 10/7/66 | |
| A | FINAL RELEASE | — | 5376 | 12/9/66 | |

LIST OF MATERIALS

| ITEM NO | QTY | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| DRAWN | J. JENNINGS | 11-9-66 | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE X ±.1 XX ±.01 XXX ±.005 ANGLES ±1° | SYSTRON DONNER CORPORATION CONCORD, CALIFORNIA |
| CHECK | | DATE | | |
| ELECT | | DATE | | |
| MECH | | DATE | | |
| PROJECT ENGR | | DATE | | |
| APPROVAL | | DATE | | |
| SCALE | — | DO NOT SCALE DRAWING | DWG SIZE D | MATERIAL — |

| USED ON | NEXT ASSY |
|---|---|
| 1017B | 17596 |
| 1037B | 17596 |
| 1034B | 17596 |
| APPLICATION | |

SCHEMATIC DIVIDE BY 3 MULTIPLIER BD.

DWG NO 17597 ISSUE A

SH 1 OF 1

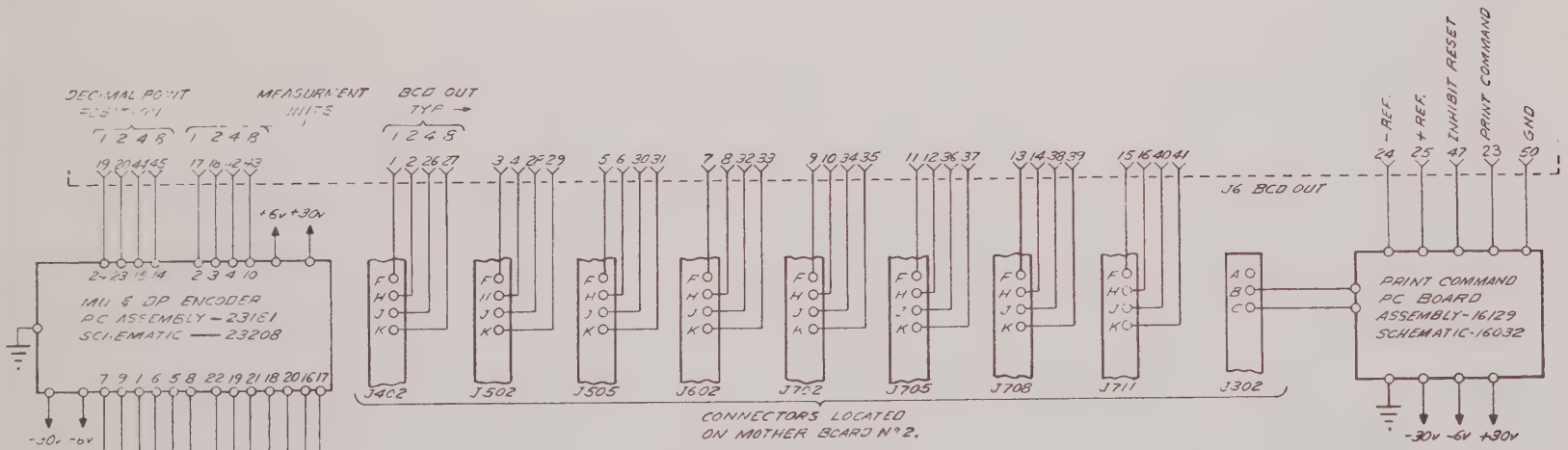
# D1 OPTION

This option provides the counter with a 1-2-4-8 BCD digital output at a rear panel BCD output connector. The D1 Option incorporates a positive logic system in which ONE = 0V ±0.5V and ZERO = -6V ±0.5V. A +30V to 0V print command step occurs at the end of each conversion. Pin connections and their translation are shown in the D1 Option Schematic.

The following drawings are a part of this option:

No. 15678 D1 Option Schematic
No. 17030 D1 Option Final Assembly
No. 23208 MU and DP Schematic
No. 23182 MU and DP PC Assembly
No. 16032E D1 Option Schematic, Print Command & Inhibit Reset
No. 16129G D1 Option P.C. Assembly, Print Command & Inhibit Reset.

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO | ECO NO | DATE | A |
| C | REDRAWN - ADDED ANNUNICATOR, LAMPS & ENCODER | | 5702 | 9/3/67 | ✓ |
| D | PRINT COMMAND WAS J6-48 | ~ | 5869 | 6-19-69 | RB |


DECIMAL POINT POSITION
1 2 4 8
MEASURMENT UNITS
1 2 4 8
BCD OUT TYP →
1 2 4 8
19 20 44 45 17 16 42 43
1 2 26 27 3 4 28 29 5 6 30 31 7 8 32 33 9 10 34 35 11 12 36 37 13 14 38 39 15 16 40 41
- REF.
+ REF.
INHIBIT RESET
PRINT COMMAND
GND
24 25 47 23 50
J6 BCD OUT
+6v +30v
2 23 15 14 2 3 4 10
MU & DP ENCODER PC ASSEMBLY - 23181 SCHEMATIC — 23208
F H J K
A B C
PRINT COMMAND PC BOARD ASSEMBLY-16129 SCHEMATIC-16032
J402 J502 J505 J602 J702 J705 J708 J711 J302
CONNECTORS LOCATED ON MOTHER BOARD N°2.
-30v -6v +30v
7 9 1 6 5 8 22 19 21 18 20 16 17
-30v -6v
SEE NOTE 1
TO J1 & TIME BASE SWITCH OF BLOCK DIAGRAM (SEE NOTE 2)
12 13 14 15 16 17
KHZ MHZ ✳ μS mS S
ANNUNICATOR
19 110 111 112 113 114 115
STANDARD
SPECIAL
DECIMAL LAMPS

NOTE:
1) OMIT THESE CONNECTIONS FOR MODELS 1017 & 1018.
2) BLOCK DIAGRAM FOR-
MODEL 1013-17450 1033-17233 1038-19237.
1017-19221 1034-17008
1018-19236 1037-15672

| ITEM NO. | QTY | PART NUMBER | DESCRIPTION | SCHEMATIC REF NO. |
|---|---|---|---|---|

LIST OF MATERIALS

| | | | |
|---|---|---|---|
| 1037 SERIES D1 OPTION | | DRAWN | DATE |
| | | CHECK | DATE |
| | | ELECT. | DATE |
| | | MECH. | DATE |
| | | PROJECT. | DATE |
| | | APPROVAL | DATE |
| USED ON | NEXT ASSY | SCALE / | DO NOT SCALE DRAWING |
| APPLICATION | | | |

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
X
XX
XXX
ANGLES ±

SYSTRON DONNER CORPORATION
CONCORD, CALIFORNIA

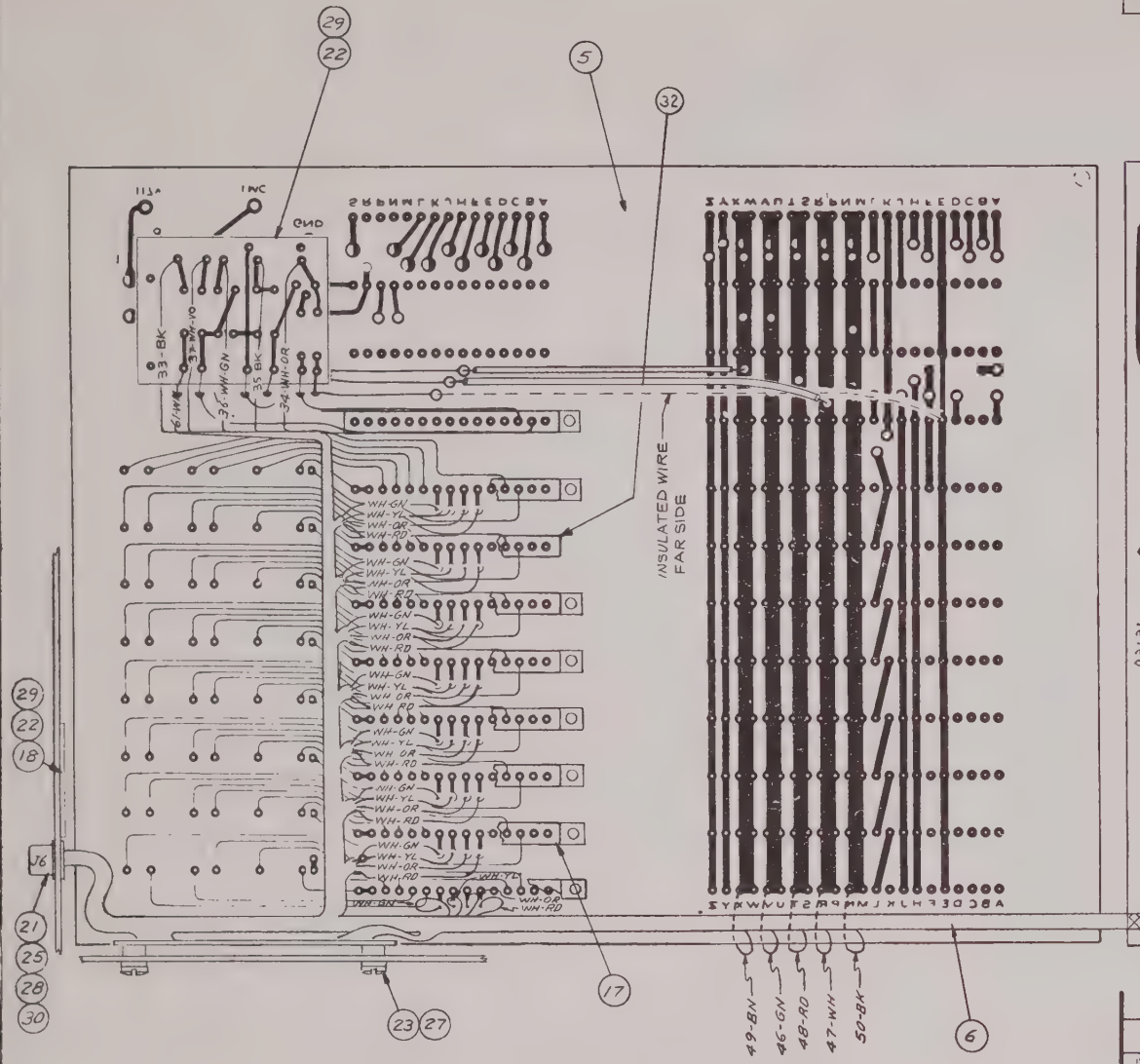
MATERIAL

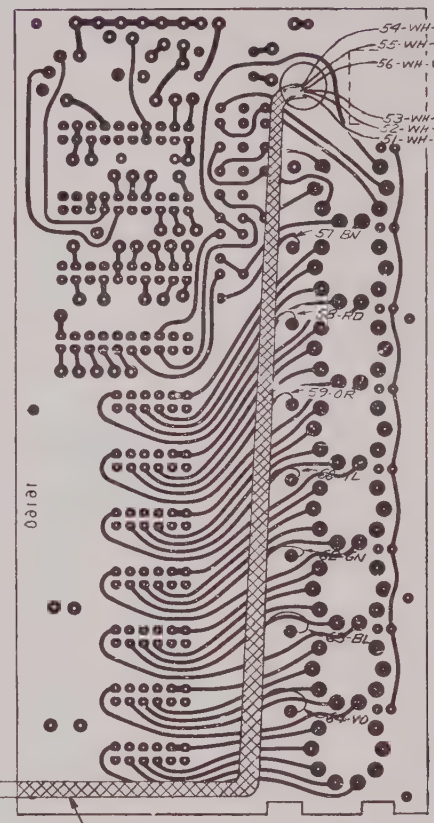
DWG SIZE C
SH / OF /

SCHEMATIC - "D1" OPTION

DWG NO. 15678

| REVISIONS | | | | |
|---|---|---|---|---|
| ISSUE | DESCRIPTION | MFR. NO. | ECO NO. | DATE |
| C | REDRAWN | | 5702 | 2-25-68 |
| D | MTG TABS ADDED TO ITEM 17; ITEM 32 WAS 17 | | 5735 | 9/6/68 |
| E | SEE ECO | | 5906 | 9/8/69 |




REAR VIEW OF ANNUNCIATOR.

FOR 1017 & 1018 REMOVE WIRES 53, 54, 55 & 56 FROM CABLE.

INDICATES RUN OF CABLE UNDER PC BOARD.

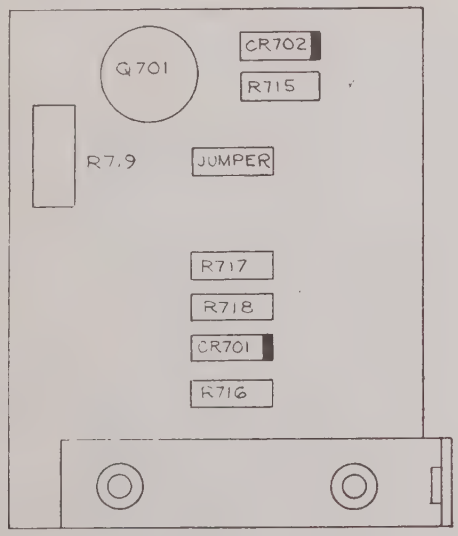
PARTS LIST- PL 17030.

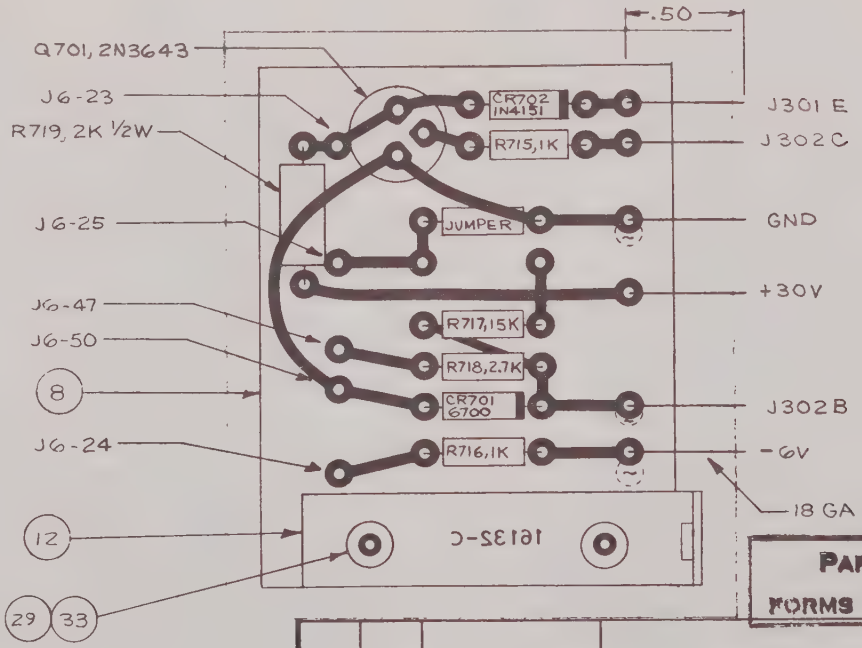
| ITEM NO | QTY | PART NUMBER | DESCRIPTION | SCHEMATIC REF NO |
|---|---|---|---|---|

LIST OF MATERIALS

| | | | | |
|---|---|---|---|---|
| 1037 SERIES D1 OPTION | DRAWN JN 1-24-69 DATE | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE .X ±.XX ±.XXX ANGLES ± | SYSTRON DONNER CORPORATION CONCORD, CALIFORNIA | D1 OPTION FINAL ASSEMBLY |
| USED ON | CHECK DATE | | | |
| NEXT ASSY | ELECT. 1-27-69 DATE | | | |
| APPLICATION | MECH. DATE | | MATERIAL | DWG NO. 17030 |
| | PROJECT 1-1-69 DATE | | | |
| | APPROVED 1-27-69 DATE | | | |
| | SCALE FULL | DO NOT SCALE DRAWING | DWG SIZE C SH 1 OF 1 | |

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO. | ECO NO. | DATE | APP. |
| G | REVISED PER ARTWORK CHANGE | | 5906 | 9-10-69 | RB |




NOTES:
1) UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE ¼W
2) SCHEMATIC REF: 16032

**PARTS LIST** PL 16129
**FORMS PART OF THIS DOCUMENT**

| ITEM NO. | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO. |
|---|---|---|---|---|

## LIST OF MATERIALS

| | |
|---|---|
| | |
| | |
| | |
| | |
| 1037 SER | |
| DI OPT | |
| USED ON | NEXT ASSY |
| APPLICATION | |

DRAWN J. MORK DATE 9-10-69
CHECK RB DATE 9-11-69
ELECT. DATE
MECH. RB DATE 9-11-69
PROJECT BAH DATE 9-11-69
APPROVAL DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
X
XX ~
XXX
ANGLES ±

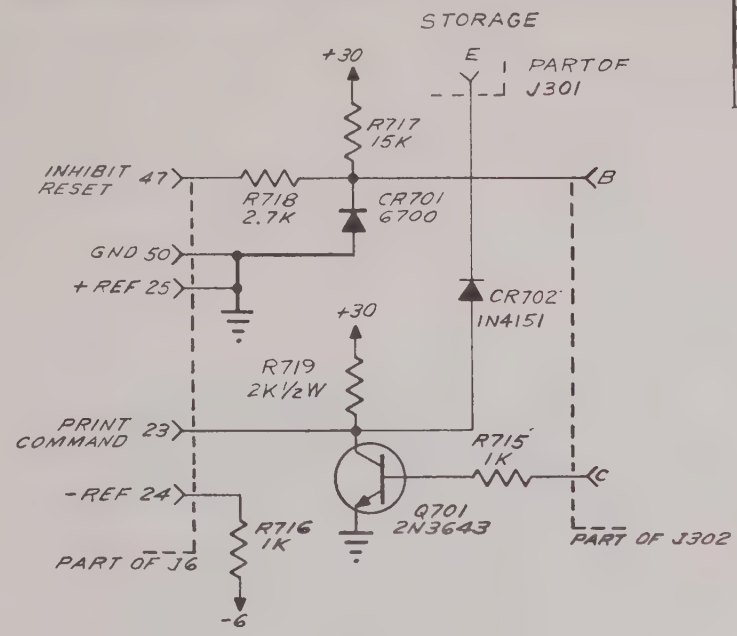
SCALE 2:1
DO NOT SCALE DRAWING
DWG SIZE B
SH 1 OF 1

SYSTRON DONNER
CORPORATION
CONCORD, CALIFORNIA

MATERIAL ~

PRINT COMMAND & INHIBIT RESET DI OPTION P.C. ASSY

DWG NO. 16129
ISSUE G




NOTE: EXCEPT AS NOTED.

1) RESISTORS ¼ W, 5%.

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO. | ECO NO. | DATE | APP'D |
| D | REDRAWN | ~ | 5869 | 6/19/69 | |
| E | CR702 & J301-E ADDED | — | 5906 | 9-10-69 | |

| ITEM NO. | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF. NO. |
|---|---|---|---|---|

LIST OF MATERIALS

| | |
|---|---|
| | |
| | |
| | |
| | |
| 1000 SERIES | |
| 01 OPTION | 16129 |
| USED ON | NEXT ASSY |
| APPLICATION | |

DRAWN JN 6-19-69 DATE
CHECK RB 6-19-69 DATE
ELECT. DATE
MECH. RB 6-19-69 DATE
PROJECT DATE
APPROVAL DATE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DECIMAL TOLERANCE
X
XX
XXX
ANGLES ±

SCALE —
DO NOT SCALE DRAWING
DWG SIZE B
SH 1 OF 1

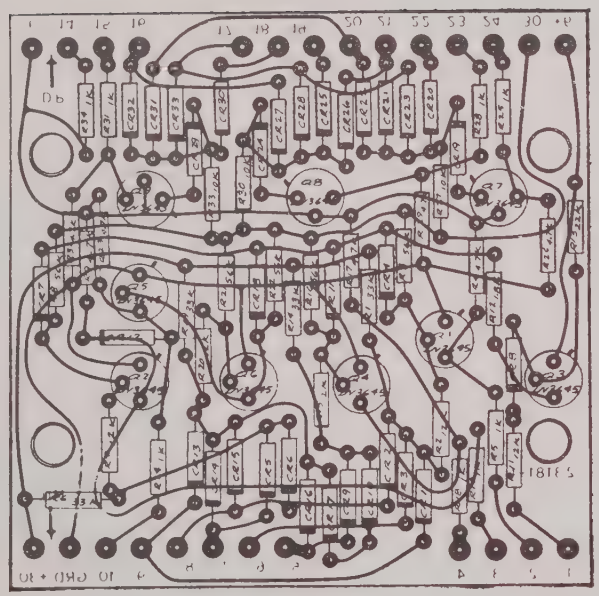
SYSTRON DONNER
CORPORATION
CONCORD, CALIFORNIA

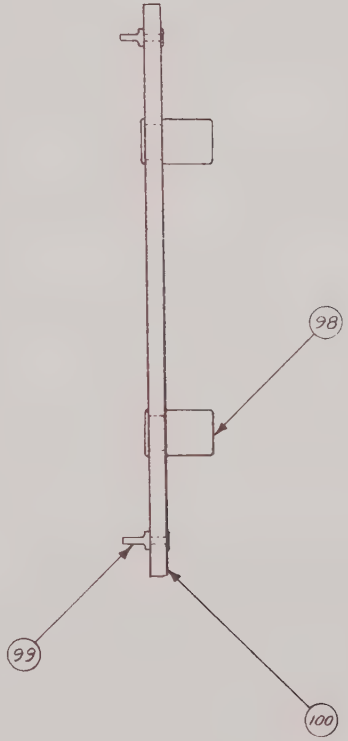
MATERIAL —

SCHEMATIC- PRINT COMMAND & INHIBIT RESET

DWG NO. 16032
ISSUE E

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER. NO | ECO NO | DATE | APP |
| A | RELEASED TO RECORDS | | 5702 | 1-25-68 | |






NOTE:

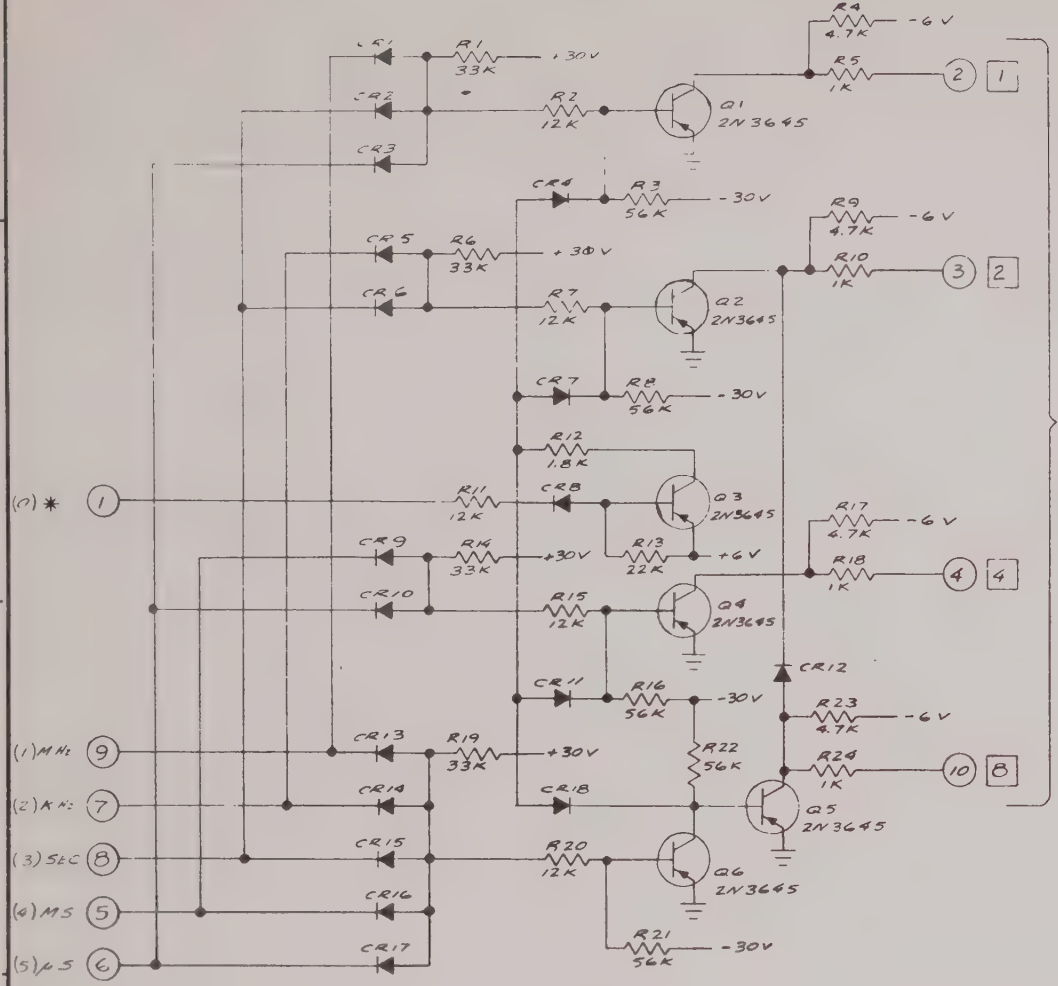
1. REFERENCE DRAWINGS:
   SCHEMATIC-23209
   PARTS LIST-23182
2. ALL DIODES 6700
3. ALL RESISTORS ± 5%, 1/4W, COMP. CARBON

| ITEM NO. | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF NO |
|---|---|---|---|---|

LIST OF MATERIALS

| | | | | | |
|---|---|---|---|---|---|
| | | DRAWN DRAWINGS 1-26-67 DATE | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE .X .XX .XXX ANGLES ± | SYSTRON DONNER CORPORATION CONCORD, CALIFORNIA | ASSEMBLY MUF DP (CODING 1-2-4-8 PA P C BOARD |
| | | CHECK — DATE | | | |
| | | ELECT. [illegible] DATE | | | |
| | | MECH. DATE | | | |
| 1037 SERIES | | PROJECT [illegible] DATE | | | |
| DI OPTION | 23915 | APPROVAL [illegible] DATE | | MATERIAL — | DWG NO 23182 |
| USED ON | NEXT ASSY | SCALE 2/1 | DO NOT SCALE DRAWING | DWG SIZE C SH 1 OF 1 | |
| APPLICATION | | | | | |

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| ISSUE | DESCRIPTION | SER NO | ECO NO | DATE | APP BY |
| A | RELEASED TO RECORDS | | 5062 | 1-25-68 | |




NOTE:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ±5%, 1/4W,
   ALL DIODES 6700.

| ITEM NO | QTY. | PART NUMBER | DESCRIPTION | SCHEMATIC REF NO |
|---|---|---|---|---|

LIST OF MATERIALS

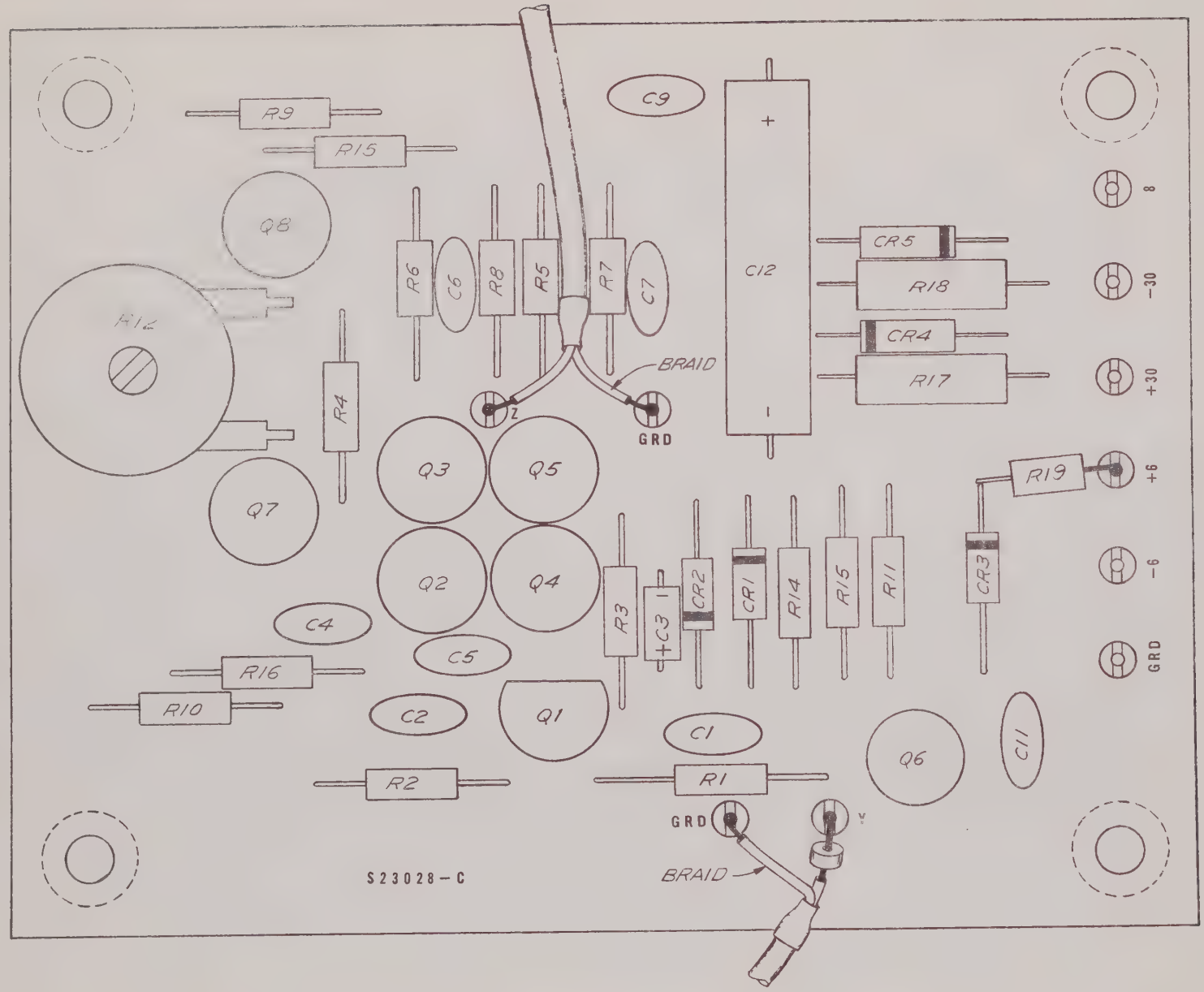
| | | | | | |
|---|---|---|---|---|---|
| | | DRAWN JENNINGS 1-26-67 DATE | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMAL TOLERANCE .X ±, .XX ±, .XXX ±, ANGLES ± | SYSTRON DONNER CORPORATION CONCORD, CALIFORNIA | SCHEMATIC MU F DP PCBD (CODING 1-2-67) |
| | | CHECK DATE | | | |
| | | ELECT. DATE | | | |
| | | MECH. DATE | | | |
| 1037 SERIES | | PROJECT DATE | | | |
| DI OPTION | 23182 | APPROVAL DATE | | MATERIAL | |
| USED ON | NEXT ASSY | SCALE | DO NOT SCALE DRAWING | DWG SIZE C | SH 1 OF 1 |
| APPLICATION | | | | | |

# ADDENDUM
# F OPTION-1000 SERIES

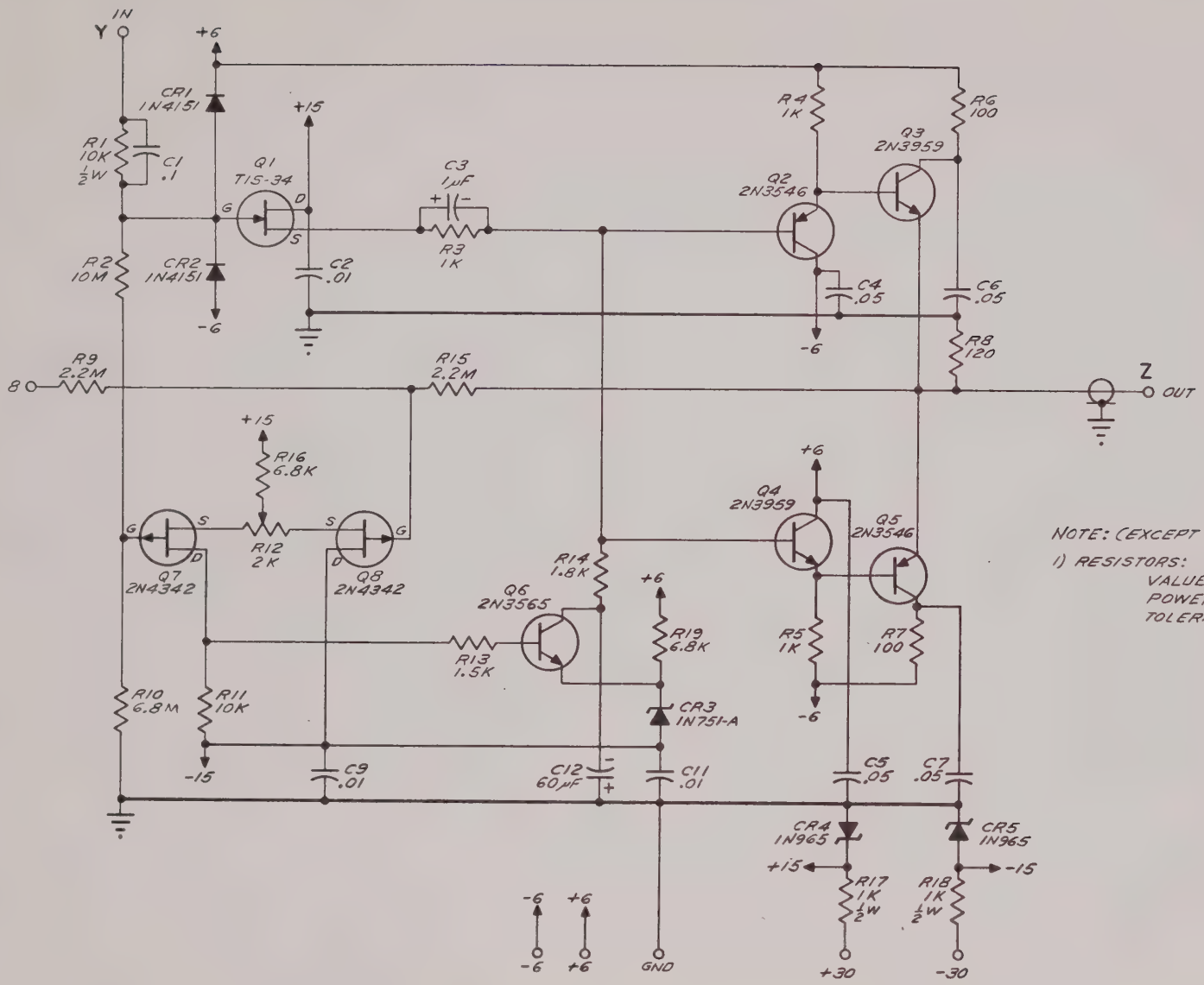
This addendum is to be included in all SD 1000 Series manuals which are to be shipped with the F Option.

The F Option, by the addition of FET amplifier circuit, increases the input impedance to 1 Megohm (shunted by 25 pF), on all counter attenuation ranges.

Two major circuit changes are involved. The input attenuation circuits (except FET) are removed from the standard input amplifier and replaced by a voltage divider mounted directly on RANGE switch S10A and a FET amplifier circuit is inserted between S10 and the "A" input of the Input Amp and Decade affording the increased input impedance. Functional operation of the FET amplifier is as follows (refer to Figure 2). The attenuated input signal is applied to the gate of Q1. The amplified input from the source of Q1 drives Q2 and Q3, the input side of a push-pull amplifier consisting of Q2, Q3, Q4, and Q5. FET differential amplifier, Q7 and Q8, sets the triggering point of the push-pull amplifier determined by the front panel LEVEL control and feedback from the output via R15. Variable resistor R12 is used to set the amplifier's output to zero in the absence of an input signal.




1 MEGOHM AMPLIFIER ASSEMBLY, DS23026

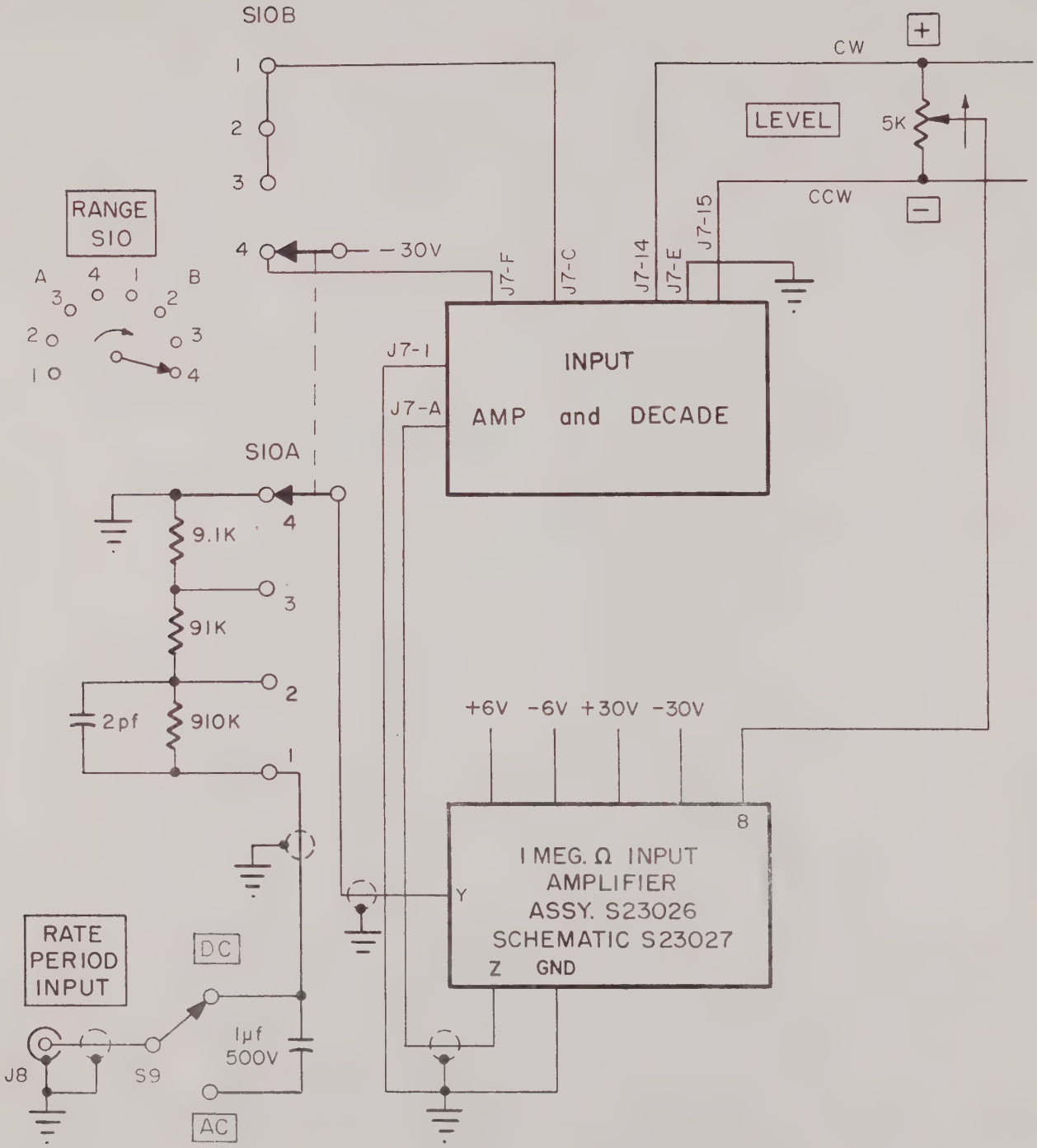



NOTE: (EXCEPT AS NOTED).

1) RESISTORS:

VALUE ——— IN OHMS.
POWER ——— 1/4 W.
TOLERANCE ——— 5%.

1 MEGOHM AMPLIFIER SCHEMATIC, DS23027

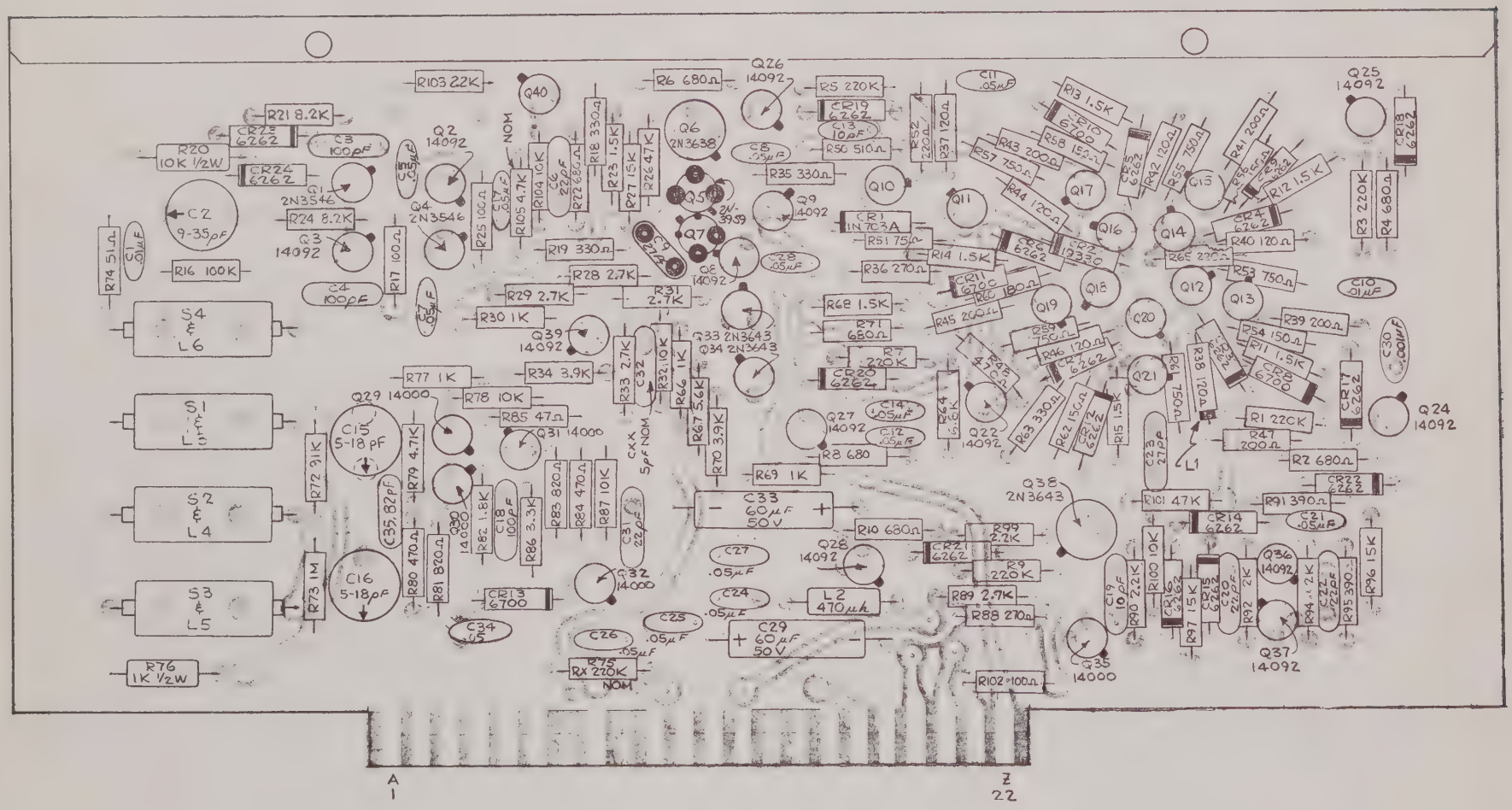



F OPTION BLOCK DIAGRAM

# ADDENDUM
# 1000 SERIES J1 OPTION

The J1 Option increases the range of the standard 50MHz counter to 100MHz by the addition of a 100MHz Readout Board and a 100MHz Amplifier and Decade Board to accommodate an input frequency of 100MHz.

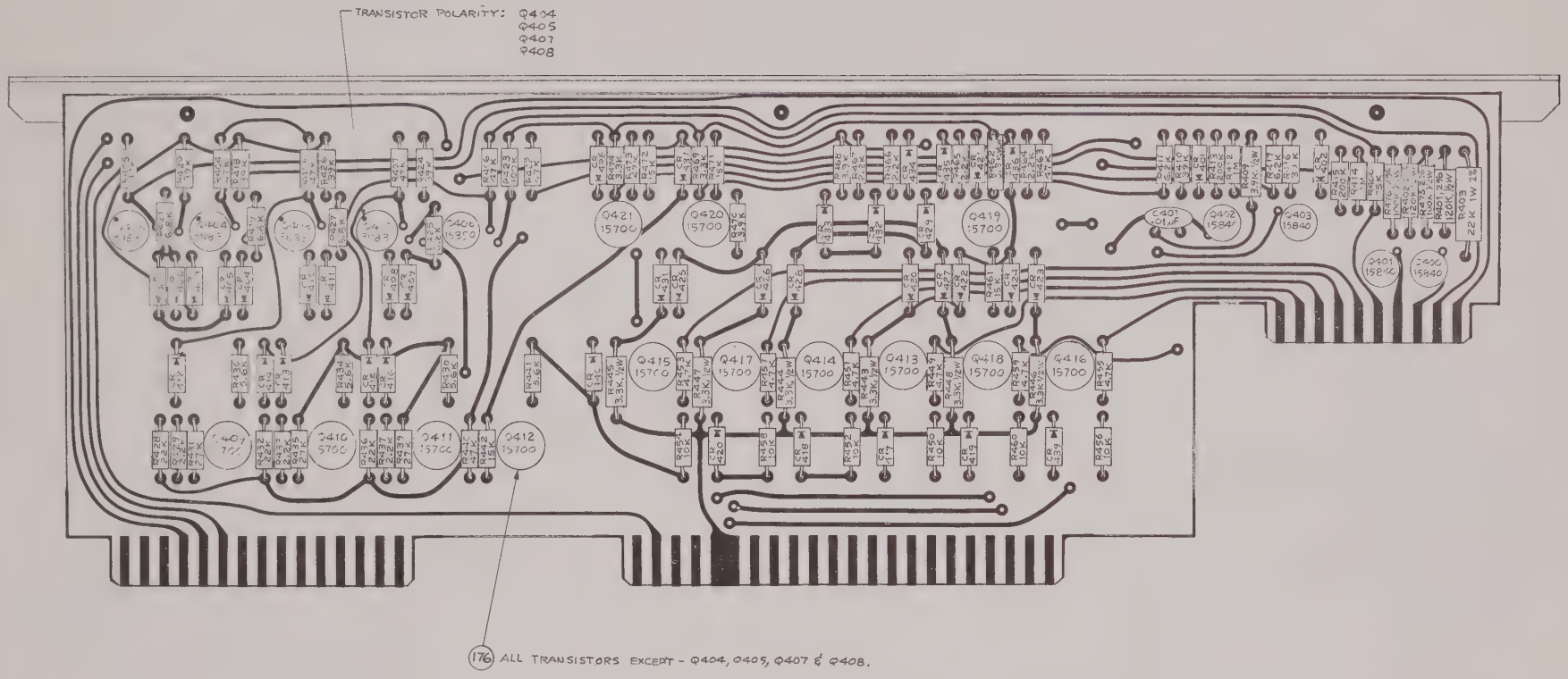
| DRAWINGS | ASSEMBLY | SCHEMATIC |
|---|---|---|
| 100MHz Amplifier and Decade | D17995F | D17992F |
| 100MHz Readout Board | D19228D | D19229C |




100MHz AMP & DECADE ASSEMBLY, D17995F

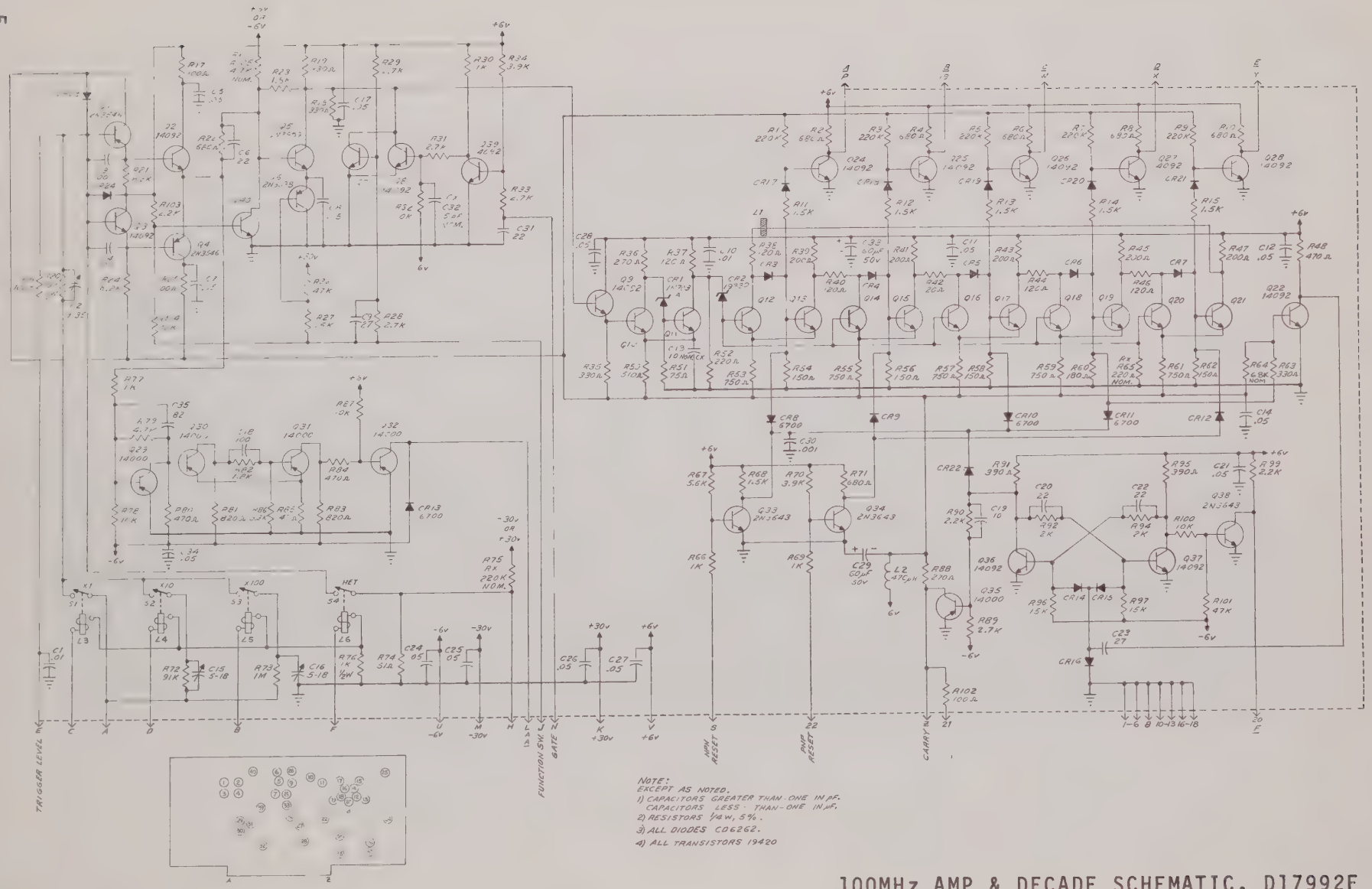
J1 OPTION

J1 OPTION



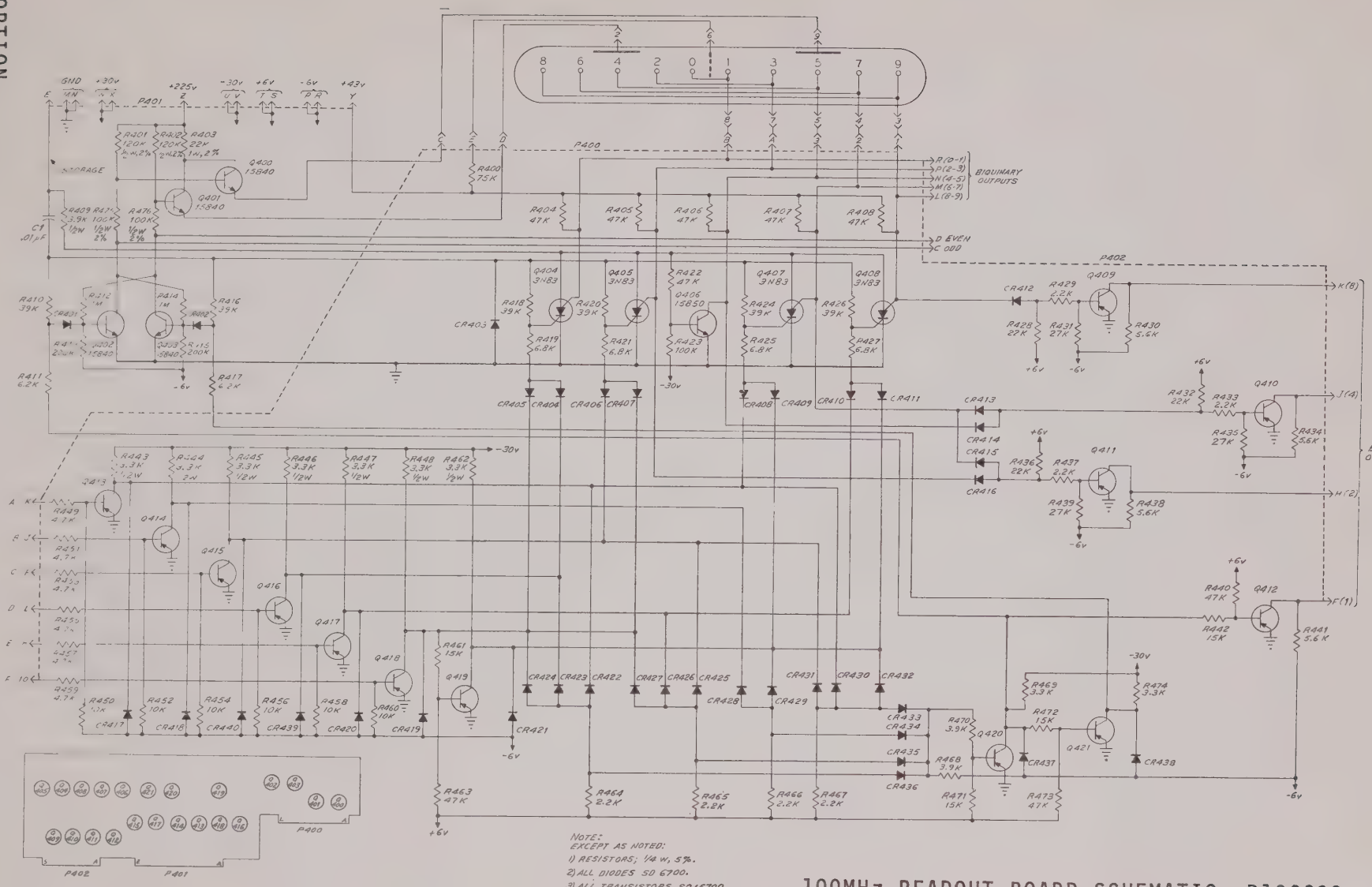

NOTE:
EXCEPT AS NOTED:
1) RESISTORS 1/4W, 5%.
2) ALL DIODES 1SD 6100.
3) SCHEMATIC: 19229.
4) PARTS LIST PL19228

100MHz READOUT BOARD ASSEMBLY, D19228D




100MHz AMP & DECADE SCHEMATIC, D17992F

J1 OPTION




100MHz READOUT BOARD SCHEMATIC, D19229C

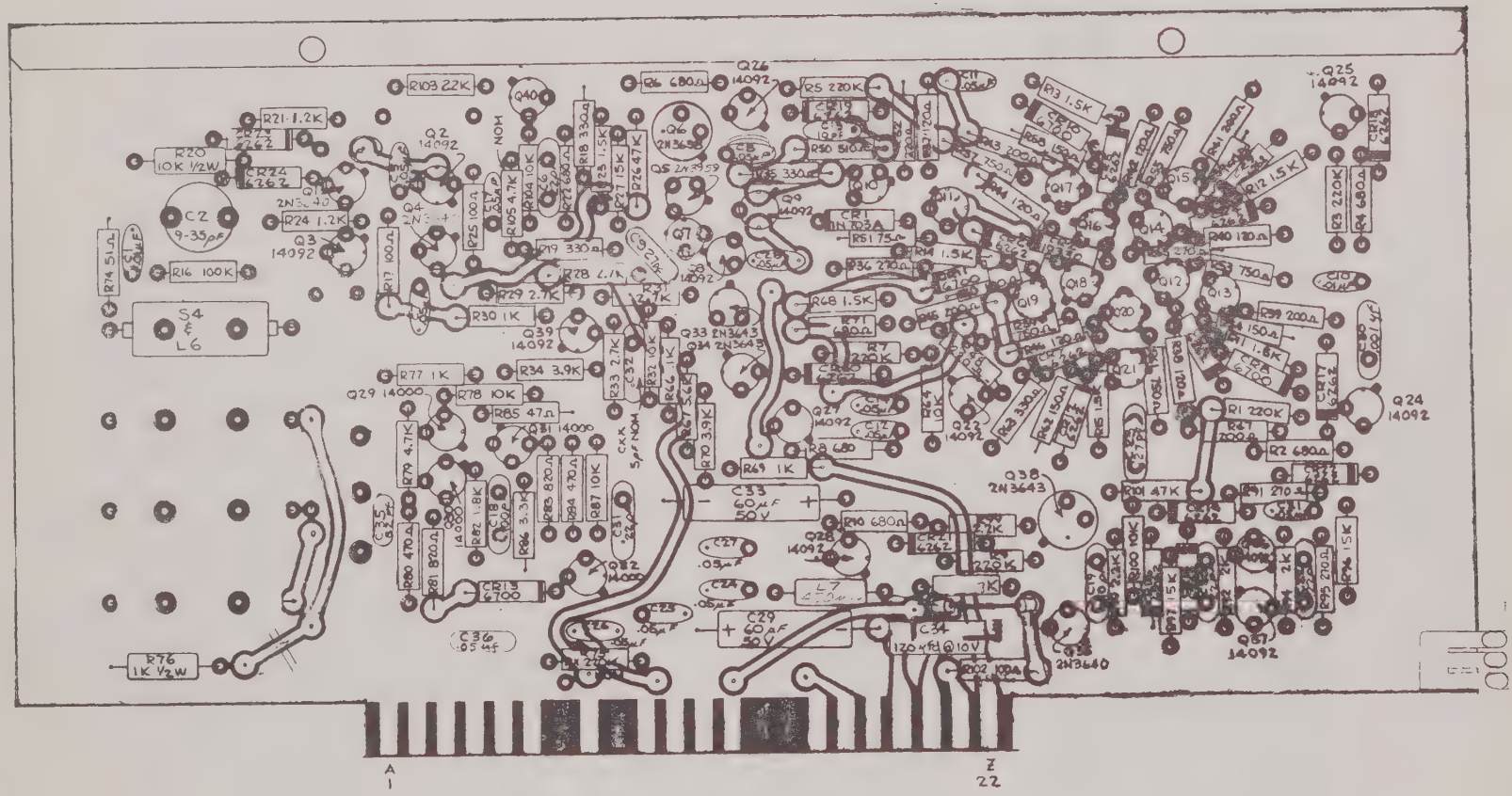
5 of 5

# ADDENDUM
# 1000 SERIES J2 OPTION

The J2 Option increases the range of the counter from 100MHz to 160MHz by decreasing the response time of the 100MHz Amplifier and Counter Board to accommodate a maximum input frequency of 160MHz.

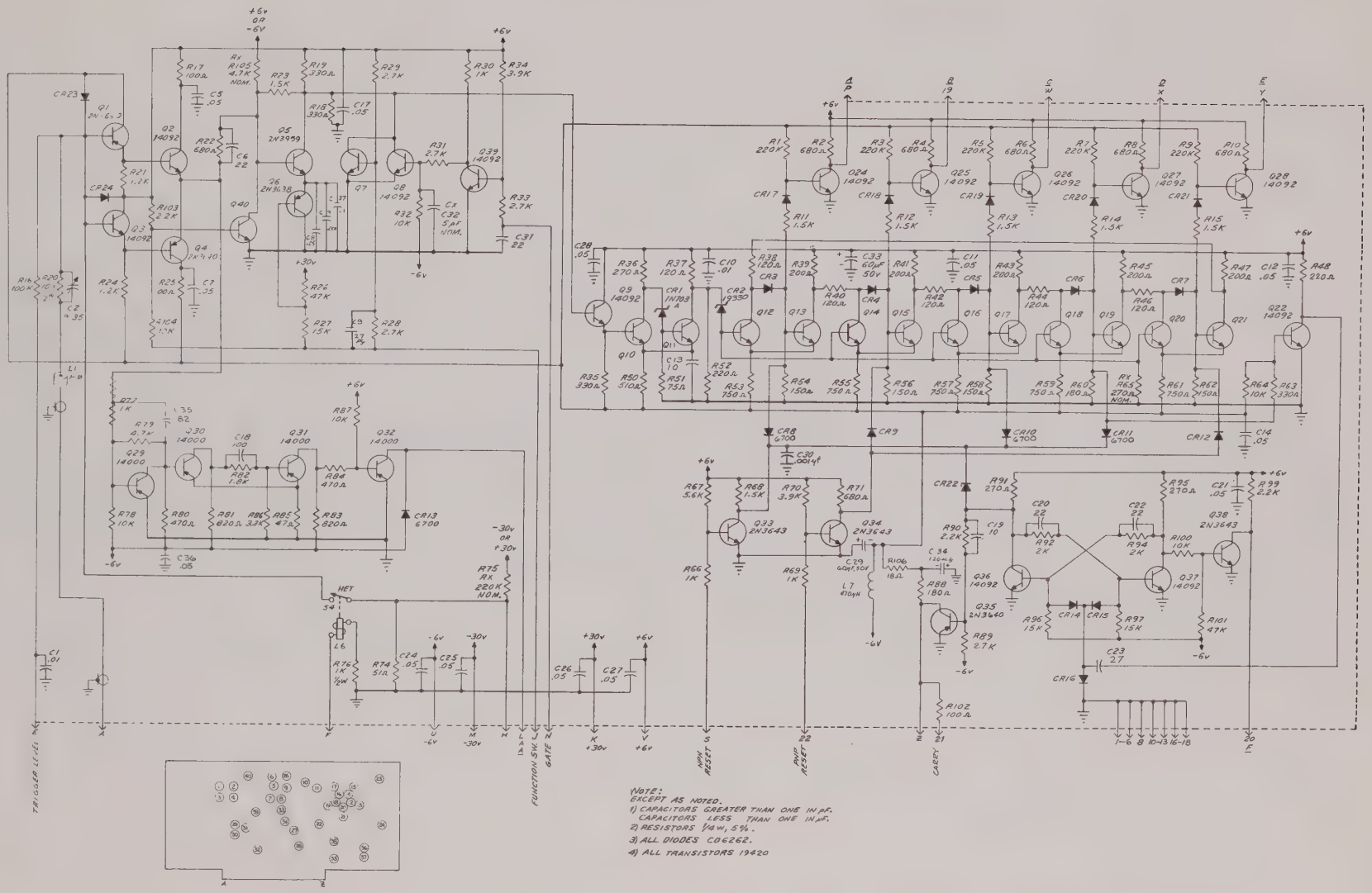
The overall Block Diagram shows the interconnection of the 160MHz and 16MHz boards with the remainder of the counter.

| DRAWINGS | ASSEMBLY | SCHEMATIC |
|---|---|---|
| 160MHz Amplifier and Decade | DS23951C | DS23967B |
| 16MHz Storage Decade | DS23396C | DS23397B |



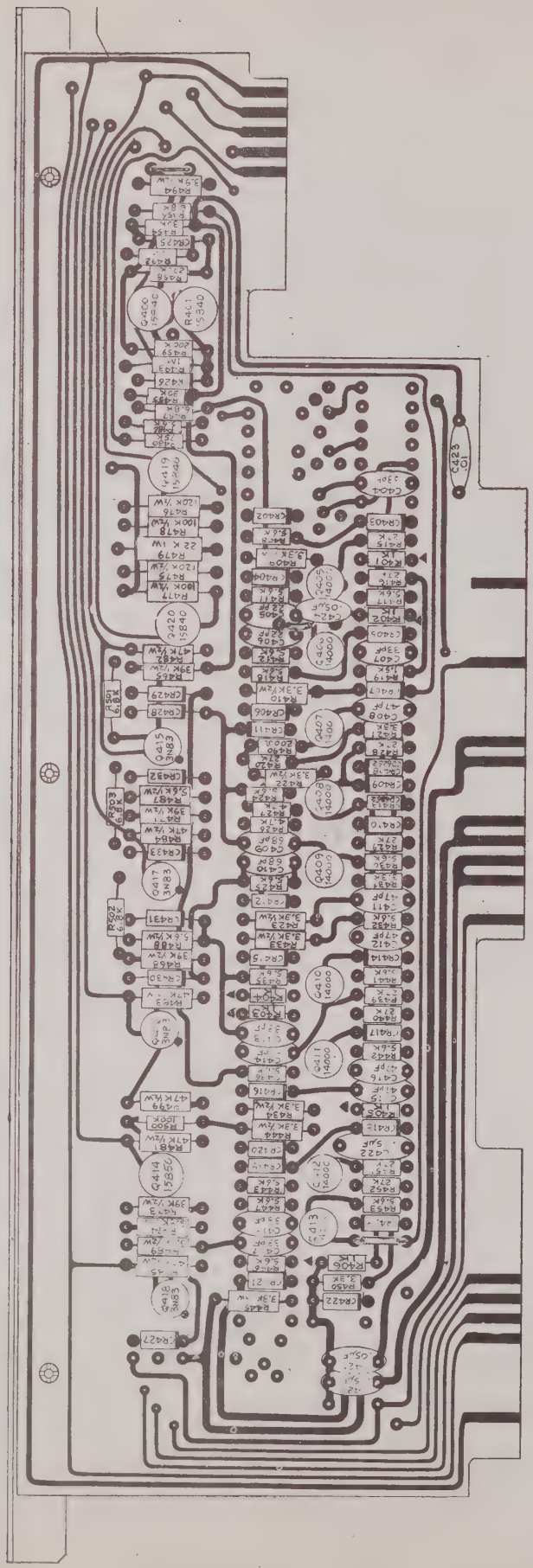

160MHz AMP & DECADE ASSEMBLY, DS23951C

J2 OPTION




NOTE:
EXCEPT AS NOTED.
1) CAPACITORS GREATER THAN ONE IN pf.
CAPACITORS LESS THAN ONE IN μf.
2) RESISTORS 1/4w, 5%.
3) ALL DIODES CD6262.
4) ALL TRANSISTORS 19420

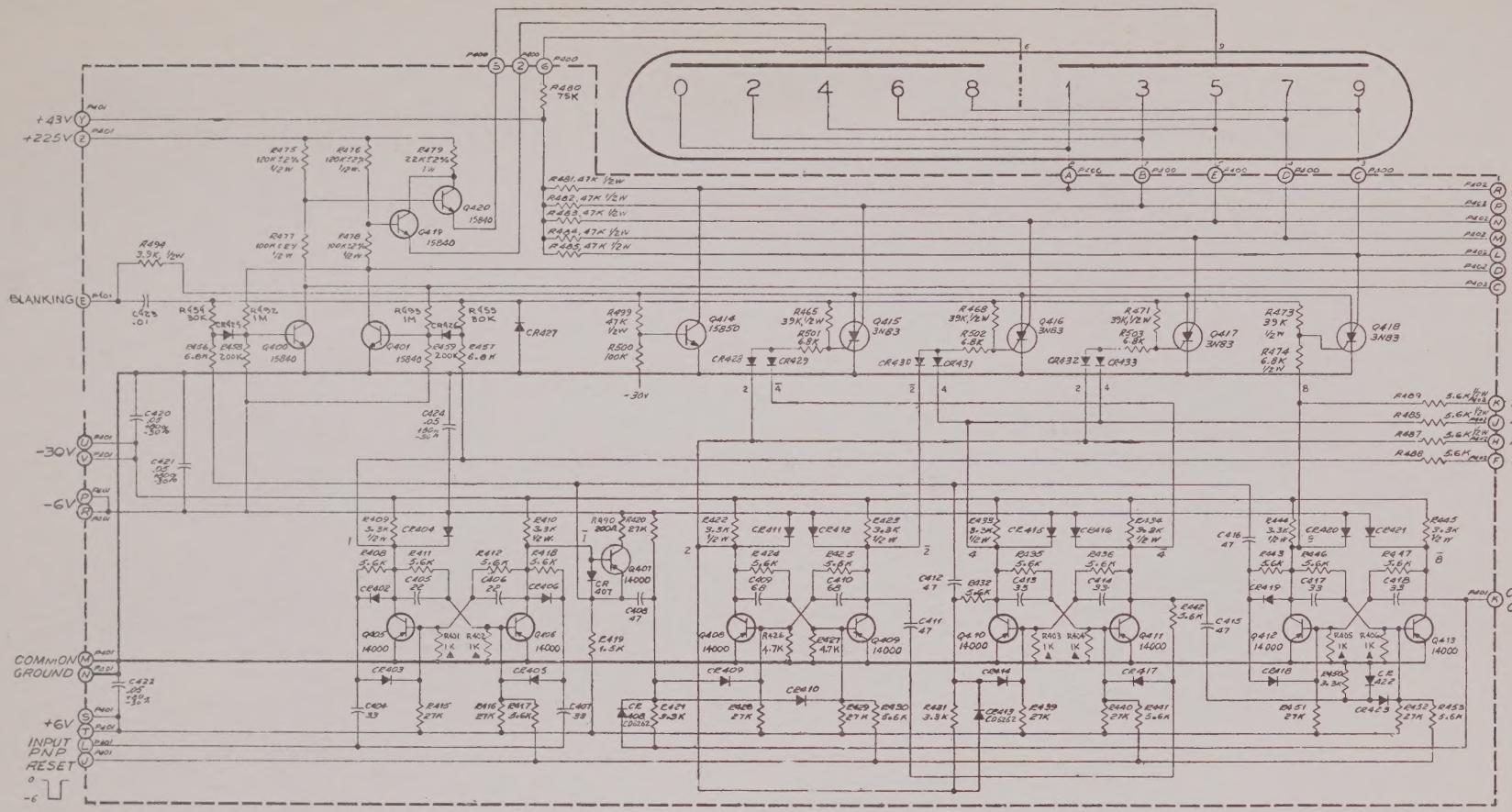
160MHz AMP & DECADE SCHEMATIC, DS23967B

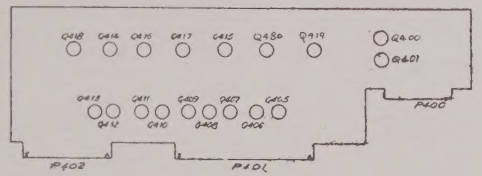


16MHz STORAGE DECADE ASSEMBLY, DS23396C



J2 OPTION



NOTES:

Unless otherwise specified

1. All resistors ±5%, 0.25 W.
2. All capacitors ±10%, 50 V min.
3. Capacitors valued <1.0 are in F.
4. Capacitors valued >1.0 are in pF.
5. All diodes per Systron Donner Spec. no. 6700.
6. Logic symbols refer to positive logic.
7. Same as 15201 except for addition of resistors marked ▲.

16MHz STORAGE DECADE SCHEMATIC, DS23397B

MP MASTER
MA28872